



Ranking European Union countries on their long-term prospects for housing price growth: a composite index

Master's Thesis
Department of Built Environment
School of Engineering
Aalto University

Espoo, 28 May 2016

Bachelor of Laws (Honours)
Master of International Economics and Management
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Title of thesis Ranking European Union countries on their long-term prospects for housing price growth: a composite index

Degree programme Degree Programme in Real Estate Economics

Major/minor Real Estate Investment and Finance

Code M3009

Thesis supervisor Professor Heidi Falkenbach

Thesis advisor(s) Professor Heidi Falkenbach

Date 28.5.2016

Number of pages 92

Language English

Abstract

A conceptual model – in the form of composite index – is put forward to highlight the comparative inflation potential of national, residential real estate markets of the European Union.

The composite index is formed from a suite of economic, demographic, sociological, and environmental variables. They are drawn from the literature as the best indicators of long-term, aggregate housing price growth for the given context.

The variables proposed are: future economic growth; future population growth; future population youthfulness; super-normal infrastructure investment; future mortgage growth; latent demand; future climate; supply inelasticity; and cyclical undervaluation.

These variables are represented in the composite index by datasets from, respectively: *The Atlas of Economic Complexity*; United Nations *World Population Prospects*; Eurostat *Europop*; European Commission *Structural Investment Funding* allocation; European Mortgage Federation *Hypostat* (outstanding loans to disposable income); Eurostat *SILC* (adults living with parents), and World Bank annual remittance data; Meldelsohn et al. (2000); Nordregio *Mountain Areas in Europe*, and Eurostat *Land Cover* (water and wetlands); and the OECD *Analytical House Price Database* (index price to income ratio).

The results indicate differences between countries in their profile for prospective long-term price growth. “Emerging” and “peripheral” countries dominate the high rankings. When compared against countries’ current average dwelling price, the results imply long term price convergence.

Keywords housing price movement, European Union house prices, housing inflation, real estate index, dwelling price growth prospects, cross-border real estate investment

Acknowledgment

This thesis has benefited from the supervisory input of Professor Heidi Falkenbach.
The author remains responsible for its shortcomings.

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1 Introduction

Over one hundred and fifty indices and rating reports compare locations based on various attributes (Moonen and Clark 2013, 2[2]).¹ Many concern real estate investment outlook.

Examples include the *Real Estate Potential Index* (Lee, 2005), *AT Kearney Real Estate Opportunity Index* (Ziegler and Buchter, 2008), *Global Real Estate Investment Attractiveness Index* (Lieser and Groh, 2011), *Hotspots 2025* (Economist Intelligence Unit, 2014), *Demographia International Housing Affordability* (Cox and Pavletich, 2015), *Winning in Growth Cities* (Cushman & Wakefield, 2015), the *City Momentum Index* (Jones Lang LaSalle, 2015), *European Regional Economic Growth Index* (LaSalle, 2015), *Emerging Trends in Real Estate* (PwC and Urban Land Institute, 2015), and the *UBS Global Real Estate Bubble Index* (Holzhey and Scokzek, 2015).

This thesis proposes another.

It aims to proffer a simple, non-technical model – in the form of a composite index (“Composite Index”) – to advance thinking about the comparative growth potential of national housing markets.

The Composite Index is not of the “benchmark” genre – it does not track price performance. Rather, it gauges the relative price growth potential of countries, in the long-term, from today. It is forward looking.

There are several reasons to be interested in this model. Firstly, it highlights the factors that seem to matter most for long-term growth of national level housing prices. Secondly, with further development and testing, it has practical relevance as an investment decision tool. Thirdly, and as will be explained later, it differs from existing indices.

The geographical scope of the Composite Index is those national housing markets of the twenty-eight members of the European Union (“EU”) for which there is sufficient relevant data.²

The research answers the following question:–

How do European Union countries rank, relative to each other, in their prospects for aggregate housing inflation, over the long-term?

From this primary question two sub-questions arise:–

In this context, and extrapolating from the existing literature, what are the key, measurable determinants of such inflation?

Which dataset appropriately reflects each determinant?

“Long-term” is assumed to be a period of at least ten years.

It has proved challenging for housing economists to forecast long-term residential price growth (Ghysels et al. 2013, 511), and they now avoid doing so (Myers and Ryu, 2008, 20).

¹ Similarly highlighted by Savenkov (2015, 1).

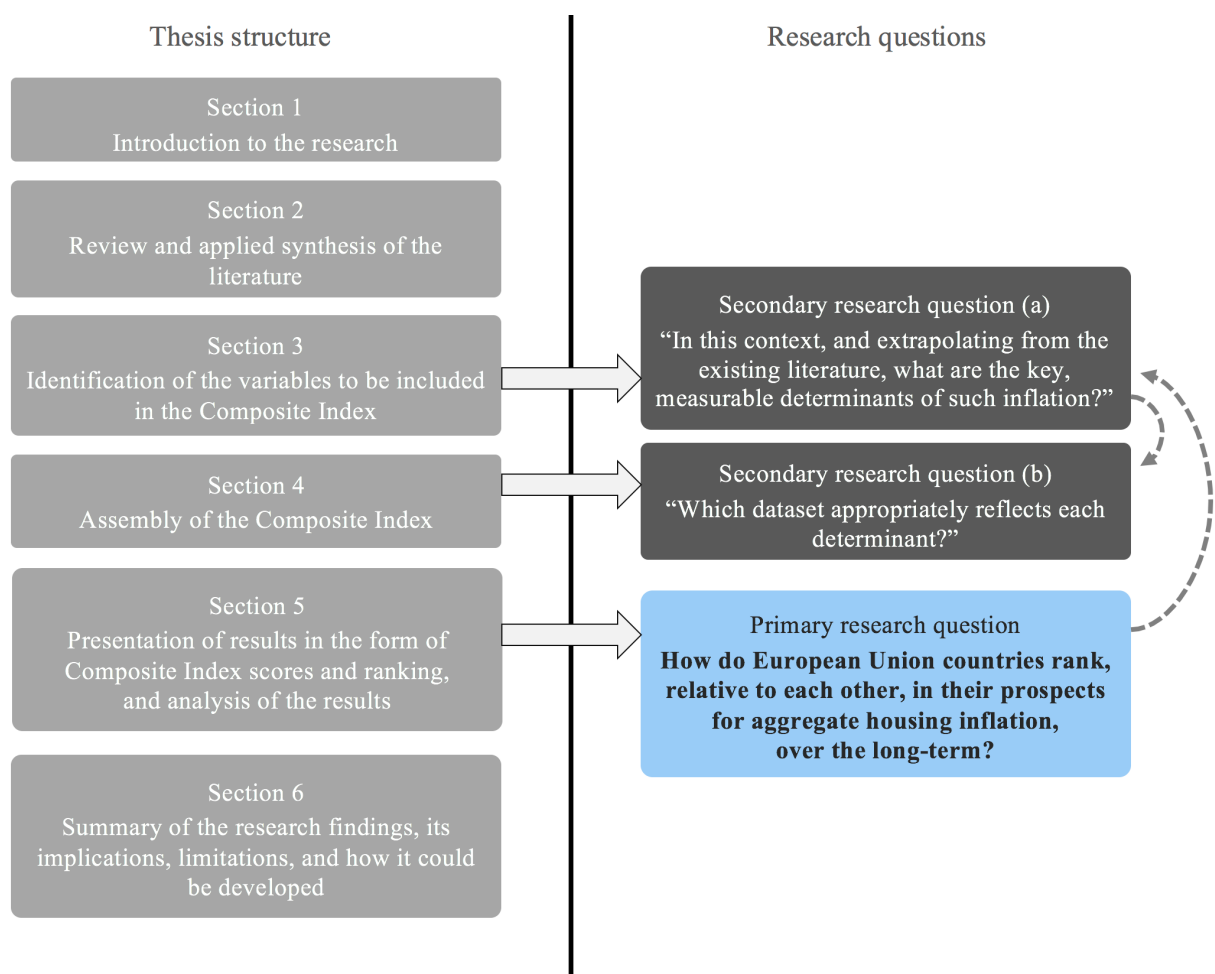
² Namely Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, The Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, and United Kingdom, but without Bulgaria, Croatia, Cyprus, Luxembourg, Malta and Romania.

This is unfortunate, for the value of the models underlying such efforts is not merely their predictive performance, as ultimately revealed. Their dissemination contributes to knowledge development, and thereby the opportunity to improve forecasting performance over time. This thesis, and the research underlying it, are motivated by improving the reliability of long range housing price forecasting.

Methodologically, this research is an explorative analysis of the literature pertaining to country-level price development of housing, augmented by an empirical component – the assembly of the composite index.

The thesis is arranged as follows. This Section 1 introduces the research. Section 2 reviews the literature on aggregate housing price determinants, prospecting for variables most relevant to the Composite Index. This purpose of the section is to ensure the variables ultimately included in the Composite Index are begot from the current state of scientific knowledge. Section 3 builds upon the findings of Section 2 to identify the key variables to be included in the Composite Index. Section 4 constructs the Composite Index, including allocating proxy datasets, then normalising and weighting the data. The purpose of this section is to enable each of the panel countries to be measured against the identified variables, and to provide transparency as to how the Composite Index works, including how variables are compared against each other. Section 5 addresses the primary research question. It presents the ranking of countries in descriptive, visual and tabular form, and discusses the results. Section 6 concludes the research. Figure 1.1 below outlines how this arrangement responds to the research questions.

Figure 1.1: The arrangement of the research – as it responds to the research questions



The research is presented in a way that allows for future back testing and development. Current back-testing is not considered appropriate/reliable given the forward looking nature of the Composite Index and data limitations – primarily the insufficiently long time series of data. This is particularly so for the EU countries that have in modern times transitioned from command or quasi-command economies. They comprise a large subset of the sample countries. Other researchers (e.g. Hilbers et al., 2001, 8; Égert and Mihaljek, 2007, 376; Vizek, 2011, 32; Haran, 2016, 29) have also noted this data deficiency.

The novelty of the Composite Index has a few dimensions.

Firstly, no known index concerning national level real estate investment outlook has focussed on comparing European Union (“EU”) member states. For example, based on econometric analysis of house prices in an aggregated selection of EU countries, Gattini and Hiebert (2010) contribute a model to forecast “euro area” but not country level house prices. Based on real estate industry interviews and survey, PWC and Urban Land Institute’s (2015, 28–29) index pair gauge European real estate investment and development prospects, but only of a selection of the most populous cities of the EU and its neighbours. Whereas many EU countries were once considered “frontier” or “emerging” territories for cross-border real estate investment, they are now more established markets, so far more likely to fall within an investor’s investment universe. This is supported by Burrell (2015), among others. Together with the EU’s continuing transition to a “common market”, this increases the likelihood that the comparative real estate investment outlook of EU countries be considered.

Secondly, several scholars have contributed indices of country attractiveness for cross-border investment, but focus wholly on risk factors (e.g. Chen and Hobbs, 2003), or blend risk factors with growth factors (e.g. Lieser and Groh, 2011). By concentrating exclusively on growth prospects, the Composite Index may potentially help investors comparing market attractiveness to assess growth prospects separately from risk and from diversification value – thus contributing to a more disciplined and robust investment decision process. This is also important because the aggregate price growth prospects of a national housing market are entirely investor-neutral, whereas its risk profile and its portfolio diversification value are partially investor-specific. Even if investors are otherwise hypothetically identical (e.g. in their existing portfolio, market knowledge, capabilities), the respective risk to them of the same investment in a particular country potentially varies by their home country – because of potential differences in say, the currency and legal system of the respective home countries.

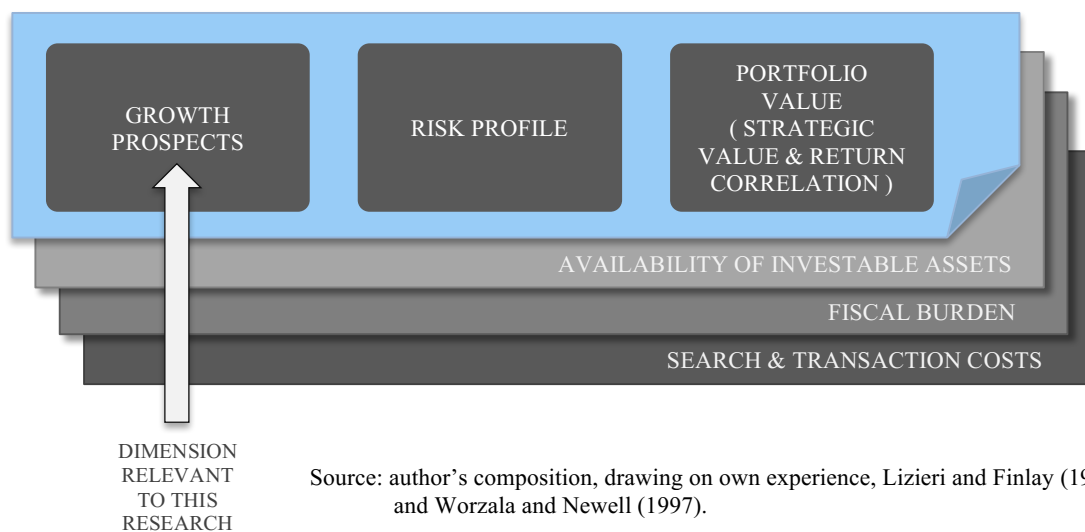
The final aspect of novelty is that the Composite Index excludes the “momentum” approach, of extrapolating a future price growth trajectory from recent past growth. This is not because the momentum approach lacks scientific merit. Today’s housing prices do persist – at least to some degree – next year and beyond, irrespective of changes in underlying market conditions. Country studies suggest that in Europe, housing price change tends to have momentum of more than one year (e.g. Posedel and Vizek, 2009; Schindler, 2014; Ott, 2014; Oikarinen and Schindler, 2015). The phenomenon has also been found elsewhere – for instance, the United States of America (e.g. Case and Shiller, 1990; Beracha and Skiba, 2011), though its duration can differ from housing market to housing market, even within countries. Because housing prices are somewhat “backward looking” they can grow (or decline) simply because of expectations shaped by price trends (e.g. Case and Shiller, 1989, 135; Mankiw and Weil, 1989, 254), so investors can potentially profit by knowing that

dwellings will be priced on this basis.³ However, the Composite Index takes a long-term view of price growth, and over the longer term, price momentum loses its relevance. Therefore, past price growth is of no direct concern. Of concern is long-term, future price growth, and the drivers of that growth.

The purpose of the Composite Index is not to *predict* long-term housing price levels. That would be arrogant and foolish.

Nor is it intended as an index of country attractiveness for investment. A disciplined process of selecting a target investment country requires multi-dimensional analysis. As shown in Figure 1.2 below, the Composite Index deals only with one such dimension.

Figure 1.2: Which country? Decision dimensions for the selection of investment markets



Rather, it is a simple model to advance thinking about the comparative growth potential of the national housing markets, and intended as a demonstrative “prototype” for potential later testing and development.

As already noted, the research is forward looking. It aims to gauge relative price growth potential, over the long-term, from now. As also noted, due to the historical context, there is currently an insufficiently long time series of data to reliably test the weighting of the variables used to construct the index. Back-testing of the Composite Index would (for now) be meaningless. That said, the composition of the index is scientifically grounded, and the research is presented in a way allowing for future testing.

The forward-looking approach, combined with the long time horizon, gives the research a futures studies flavour. Like futures studies, it is unashamedly open to criticism for a lack of empirical rigour. As de Jouvenel – a leading originator of the discipline – put it (1965, 2), “[t]hey said it was unscholarly, which of course it is, but happens to be necessary. It is unscholarly perforce because there are no *facts* in the future” [emphasis in original]. Renown Finnish academic Pentti Malaska made a similar point, noting that “futures [studies] beliefs are different from conventional scientific beliefs because they claim

³ Though studies considering the matter generally acknowledge that a strategy of short-term trading just to exploit this effect would be unprofitable due to transaction costs (Gatzlaff & Tirtiroglu, 1995, 181).

something about a contingent...object, and thus the truth of claim concerns...what is possible and not what is factual” (Malaska, 2000, 5). On empiricism he observed that whilst “futures [studies] has no domain of empirical observations of its own...accumulated empirical knowledge gained by any sciences can and should be utilized in futures [studies]” (Malaska 2000, 7).

In considering housing “price”, the research, and the resulting Composite Index, make no distinction between the price to rent housing and the price to purchase it. Although it is recognised that the two have somewhat different drivers, over the long-term, dwelling prices and rents are co-integrated (Ambrose et al., 2013, 490). In Europe, most of the variability in housing price is attributable to rental yield, especially in the long-term (e.g. Hiebert and Sydow, 2011).

Another distinction not reflected in the Composite Index is that “housing” has different physical components. It comprises: (1) land; and (2) the structures attached to that land. Taking this perspective, Bostic et al. (2007, 206) highlight that because the value of these components do not necessarily change in unison, “properties that vary in terms of how value is distributed between land and improvements will show different price changes *in response to the same economic shock to land values*” [emphasis in original]. They also contend, and substantiate empirically, that the land component is more important than the structures to determining housing price change. The contention is supported by Davis and Heathcote (2007), who find, using a larger geographical area for empirical testing, that the land component is primarily responsible for movements in housing price. This is also confirmed by the subsequent efforts of others, including Bourassa et al. (2011), and Diewert et al. (2015). The current research does not decompose housing into its physical components. This is for simplicity, and because the distinction becomes far less important at the national aggregate level.

2 Determinants of future housing price

Mainstream theoretical economics considers housing price to fundamentally reflect the interaction between housing supply and its demand (e.g. Smith, 1969, 796; Kenny, 1999, 389; Abelson et al., 2005, 97; Kohler and van der Merwe, 2015, 22).

Demand is deemed to be influenced by factors such as expected future benefits and costs of owning/occupying the dwelling (e.g. Poterba, 1984, 730; Abelson et al., 2005, 97), expectations about future housing price (e.g. Dougherty and Van Order, 1982; Glaeser et al., 2008, 199), changes in real disposable income (e.g. Smith, 1969, 796; Abelson et al., 2005, 97), labour market trends (e.g. Johnes and Hyclak, 1999), demographics (e.g. Ortalo-Magné and Rady, 1999; Abelson et al., 2005, 97), financing constraints and costs (e.g. Smith, 1969, 796; Engelhardt, 1994; Stein, 1995), search costs (e.g. Chinloy, 1980, 280), transaction costs (e.g. Edin and Englund, 1991, 299), and opportunity costs (e.g. Poterba, 1984, 732).

Developing new housing can address market demand, but is slow or even impossible – due to factors such as regulation (e.g. Sheppard, 2005), the availability and cost of developable land (e.g. Smith, 1969, 796), construction costs (e.g. Smith, 1969, 796) and design and construction lags (e.g. Caldera and Johansson, 2013, 232).

Housing prices increase (/decrease) to reflect the insufficiency (or oversupply) of required housing stock.

A rich body of empirical studies generally support the theoretical understanding of housing price dynamics. Table 2.1 commencing on the following page provides a selected overview of some such studies – specifically, the current generation of empirical studies on the determinants of aggregate dwelling price. The selection focuses on those studies most relevant to the Euro area, where available.

As is evident from Table 2.1, the studies suggest that housing price reacts to a wide range of demand/supply variables including economic, demographic, institutional, and environmental factors.

No empirical study assesses the respective impact of a range of variables from all these categories – let alone at the national level and spanning the EU countries. Studies mostly assess a compact range of potential explanatory variables, especially economic and demographic factors. In terms of underlying impact on housing prices, institutional factors are less frequently addressed empirically, and environmental factors rarely so.

Table 2.1: Selected survey of contemporary empirical literature on aggregate housing price determinants

Investigator(s)	Country	Sample period	Co-integrating regression approach	Variable(s) shown to have a significant relationship with real housing price change
Adams & Füss (2010)	Australia, Belgium, Canada, Denmark, Finland, France, Great Britain, Ireland, Italy, the Netherlands, New Zealand, Norway, Spain, Sweden, USA.	1975–2007 (quarterly)	Panel DOLS	<ul style="list-style-type: none"> Economic activity (+ve), as measured by real GDP, real industrial production, real consumption, real money supply & employment Construction costs (+ve) Long-term interest rate (-ve)
Algieri (2013)	Germany, France, Italy, Netherlands, Spain, UK, USA.	1970–2010 ⁴ (quarterly)	ECM	<ul style="list-style-type: none"> Population growth (+ve) Per capita GDP (+ve) Equity market prices (+ve) Sustained inflation adjusted price growth (+ve) “Stochastic trends”
Almeida et al. (2006)	Australia, Belgium, Canada, Chile, Denmark, Finland, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, Korea, Malaysia, Netherlands, New Zealand, Norway, Singapore, Spain, Sweden, Switzerland, Taiwan, Thailand, UK, USA.	1970–1999 (annual)	OLS	<ul style="list-style-type: none"> Ratio of housing price to real GDP per capita (-ve) Long-term interest rate (-ve) Real GDP (+ve)
Annett (2005)	Belgium, Finland, France, Germany, Italy, Ireland, Netherlands, Spain.	1970–2003 (annual)	ECM, panel DOLS	<ul style="list-style-type: none"> Real income (+ve) Real credit (+ve) Excess money supply (+ve)
Antipa & Lecat (2010)	France, Spain	1980–2008 for France, 1982–2007 for Spain, (quarterly)	2 stage least squares, ECM.	<ul style="list-style-type: none"> Household disposable income (+ve) Population growth (+ve) Borrowing capacity (+ve) Construction costs (-ve) Housing supply (-ve)
Arestis & González (2014)	Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, UK, USA.	1970–2011 (annual)	VECM	<p>In the long term:–</p> <ul style="list-style-type: none"> Real disposable income (+ve) Housing supply (-ve) Employment levels (in a handful of the countries studied).

⁴ Notably, this is one of the minority of studies in which the period of the global financial crisis is included in the dataset.

Investigator(s)	Country	Sample period	Co-integrating regression approach	Variable(s) shown to have a significant relationship with real housing price change
Bessone et al. (2005)	France (Paris)	1986–2004 (quarterly)	Johansen Maximum Likelihood	<ul style="list-style-type: none"> Housing supply (-ve) Household income (+ve)
Borowiecki (2009)	Switzerland	1991–2007 (annual)	VAR	<ul style="list-style-type: none"> Growth of population (aged 20–64) (+ve) Construction costs (+ve) Equities market price growth (+ve) Housing supply (-ve) Real interest rates (-ve, but only moderately so)
Bourassa et al. (2011)	Switzerland	1978–2008 (annual)	ECM	<ul style="list-style-type: none"> GDP per capita (+ve) Construction costs (+ve) Growth of population (aged 30–49) (+ve)
Dewilde & Lancee (2013)	26 EU member states, plus Iceland and Norway.	2003–2008 (annual)	OLS	Income inequality (+ve)
Égert & Mihaljek (2007)	19 OECD countries, plus 8 transition economies of eastern Europe.	1975–2005 (of part thereof where data unavailable) (quarterly)	Panel DOLS	<ul style="list-style-type: none"> GDP per capita (+ve) Real interest rate (-ve) Credit volume (+ve)
Englund & Ioannides (1997)	Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, Sweden, UK, USA.	1970–1992 (annual)	OLS	<ul style="list-style-type: none"> GDP growth (lagged) (+ve) Real interest rate (-ve)
Fitzpatrick & McQuinn (2007)	Ireland	1981–1999 (annual)	DOLS, fully modified OLS, OLS	<ul style="list-style-type: none"> Mortgage credit (+ve) Housing supply (-ve) Growth of population (aged 24–36) (+ve)
Ganoulis & Gioliodori (2011)	Belgium, Denmark, Finland, France, (West) Germany, Ireland, Italy, Netherlands, Spain, Sweden, UK.	1970–2004 (annual)	Panel ECM	<p>In the long term:</p> <ul style="list-style-type: none"> Real income (+ve) Interest rates (-ve) Mortgage debt per capita (only modestly +ve)
Gattini & Hiebert (2010)	Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Spain.	1970–2009 (quarterly)	VECM	<ul style="list-style-type: none"> Real per capita disposable income (+ve) Real housing investment (-ve) Interest rates (-ve)
Gerdesmeier et al. (2015)	Euro area as a whole	1983–2011 (quarterly)	Quantile regression	<ul style="list-style-type: none"> % of working age population (+ve) Employment rate (+ve) Per capita disposable income (+ve) Housing stock per capita (-ve) Household debt to income ratio (-ve) Ownership costs (-ve)

Investigator(s)	Country	Sample period	Co-integrating regression approach	Variable(s) shown to have a significant relationship with real housing price change
Gounopoulos et al. (2012)	Greece	1985–2010 (quarterly)	VECM	<ul style="list-style-type: none"> Real wages (+ve) Construction costs (+ve) Real long-run interest rate (-ve) Informal economy (-ve) Economic output excluding the construction sector (-ve)
Goodhart & Hofmann (2008)	Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, Spain, Sweden, Switzerland, UK, USA.	1973–2006 (quarterly)	Panel VAR	<ul style="list-style-type: none"> GDP (+ve) M3 money aggregate (+ve) Credit (+ve) Interest rates (-ve) General inflation (+ve/-ve)
Hilber & Vermeulen (2016)	England	1974–2008 (annual)	OLS, 2 stage least squares.	<ul style="list-style-type: none"> Earnings (+ve) Regulatory constraints (+ve) % of developable land already developed (+ve) Uneven topography (modestly +ve)
Hirata et al. (2013)	Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, UK, USA	1971–2011 (quarterly)	Factor augmented VAR	<ul style="list-style-type: none"> Interest rates (-ve) <p>(Productivity shocks are not found to have a significant impact on long-term house prices.)</p> <p>Neither is credit supply, at least not minor supply fluctuations.)</p>
Holly & Jones (1997)	United Kingdom	1939–1994 (annual)	Asymmetric ECM	<ul style="list-style-type: none"> Real income (+ve)
Hort (1998)	Sweden (20 urban areas)	1967–1994 (annual)	Restricted ECM	<p>In the long run:–</p> <ul style="list-style-type: none"> Per capita income (+ve) Construction costs (+ve) Ownership costs (+ve)
Huynh-Olesen et al. (2013)	Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia.	1999–2011 (quarterly)	Panel DOLS	<ul style="list-style-type: none"> Gross disposable income (+ve) Population growth (+ve) Interest rates (-ve) Credit volume (+ve) Remittances received (+ve)
Jacobsen & Naug (2005)	Norway	1990–2004 (quarterly)	ECM	<ul style="list-style-type: none"> Disposable income (+ve) Employment level (+ve) New housing supply (-ve) Interest rates (-ve) <p>(Rental income and general consumer prices were found to have weak explanatory power.)</p>

Investigator(s)	Country	Sample period	Co-integrating regression approach	Variable(s) shown to have a significant relationship with real housing price change
Jadevicius (2016)	Lithuania	1996–2013 (quarterly) ⁵	Granger causality	<ul style="list-style-type: none"> • Employment • Foreign direct investment • Inflation • Sentiment <p>Notably, no meaningful causality with GDP, GDP per capita, or population was found.</p>
Jud & Winkler (2002)	USA (130 metropolitan areas)	1984–1998 (annual)	OLS	<ul style="list-style-type: none"> • Population growth (+ve) • Real income (+ve) • Construction costs (+ve) • Equity market price growth (+ve) • Land supply restrictions (+ve)
Kahn (2009)	USA	2000	Hedonic house price regression	<ul style="list-style-type: none"> • January average temperature (+ve) • July average temperature (-ve) • January and July average rainfall (-ve)
Karaman Örsal (2014)	Australia, Austria, Belgium, Canada, Finland, Netherlands, New Zealand, Norway, Sweden, Switzerland, UK, USA	1989–2010 (quarterly)	Likelihood-based panel co-integration test, panel VAR.	<ul style="list-style-type: none"> • Real GDP per capita (+ve) • Real long term interest rates (+ve) • “Stochastic trends”
Kasparova & White (2001)	Germany, Netherlands, Sweden, UK	1979–1998 (annual)	ECM	<p>In the long run:</p> <ul style="list-style-type: none"> • Real GDP (+ve), except for Netherlands • Real mortgage interest rates (varies by country, but overall a minor impact) • Housing supply (generally -ve)
Kholodilin & Ulbricht (2015)	48 large European cities	2012	Bayesian model averaging, OLS, quantile regression	<ul style="list-style-type: none"> • Mortgage per capita (+ve) • Population density (+ve) • Employment levels (+ve) • Income inequality (+ve, but only moderately so)
Ling et al. (2015)	USA	1990–2010 (quarterly)	VAR	<ul style="list-style-type: none"> • Sentiment (+ve), even up to five years • Sales turnover rate (+ve)
Määttänen & Terviö (2014)	USA (6 metropolitan cities)	1998–2007 (annual)	Cross-section	Inequality of (total disposable) income (-ve)
Maennig & Dust (2008)	Germany (98 metropolitan areas)	2002 ⁶	Cross-section	<ul style="list-style-type: none"> • Relative population size (+ve) • Population decline reduces house price, but population growth has no significant effect. • Disposable income (+ve) • Construction costs (+ve)

⁵ Unlike most studies, Jadevicius (2016) tests nominal rather than real dwelling prices.

⁶ The real estate data used was for detached dwellings of medium quality.

Investigator(s)	Country	Sample period	Co-integrating regression approach	Variable(s) shown to have a significant relationship with real housing price change
Matlack & Vigdor (2008)	USA	1970, 1980, 1990, 2000. ⁷	OLS	Income inequality (+ve), where elasticity of supply is small
Mayer & Gareis (2013)	Ireland	1997–2008 (quarterly)	Bayesian DSGE model, OLS	Monetary shocks shown to have negligible impact on housing price. Of other structural shocks, housing preferences the primary driver, and supply technology the secondary driver of price variation. Specifically: <ul style="list-style-type: none"> • Innovation (+ve) • Population aged 25–44 (+ve) • Population less young population (-ve) • Real interest rate (-ve)
Meen (2002)	UK, USA	1969–1996 for UK, 1981–1998 for USA, (quarterly)	ECM	<ul style="list-style-type: none"> • Household disposable income (+ve) • Household wealth (+ve) • Real interest rates (-ve) • Housing supply (-ve)
Meir & Rehdanz (2016)	Britain	1998, 2003, 2008	Hedonic house price regression	<ul style="list-style-type: none"> • Milder temperatures (+ve) • Extreme weather (-ve)
Muellbauer & Murphy (1997)	UK	1957–1994 (annual)	OLS	<ul style="list-style-type: none"> • Real income (+ve) • Real interest rates (-ve) • New housing stock (-ve)
Ott (2014)	Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Spain.	1970–2012 (annual)	Panel ECM	In the long-run:– <ul style="list-style-type: none"> • Disposable income (+ve) • Interest rates (-ve) • New housing stock (-ve) • Mortgage volume (+ve)
Paciorek (2003)	USA	1984–2008 (annual)	OLS	Housing supply regulation (+ve)
Posedel & Vizek (2009)	Croatia, Estonia, Ireland, Poland, Spain, UK.	1996–2007 (annual)	Structural VAR	<ul style="list-style-type: none"> • Real GDP (+ve) • Real interest rates (+ve) • Mortgage volume (+ve) • Real lagged real house prices (+ve)
Rehdanz & Maddison (2009)	Germany	1999	OLS (supporting a hedonic housing model)	Include climatic variables, especially January average temperature (+ve), and July average temperature (-ve), and January and July rainfall (-ve).
Saita et al. (2016)	Japan, USA	1976–2010 (Japan), 1975–2011 (USA), (annual)	Panel DOLS	<ul style="list-style-type: none"> • GDP per capita (+ve) • Population (+ve) • Old age dependency ratio (-ve)
Saiz (2010)	USA	1970–2000 (annual)	OLS	<ul style="list-style-type: none"> • Restrictive geography (+ve)

⁷ Rental price data, not asset price data.

Investigator(s)	Country	Sample period	Co-integrating regression approach	Variable(s) shown to have a significant relationship with real housing price change
Sussman et al. (2014)	USA	2000	Hedonic house price regression	<ul style="list-style-type: none"> January average temperature (+ve) July average temperature (-ve, over the relevant range)
Takáts (2012)	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Korea, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK, USA	1970–2009 (annual)	Panel DOLS	<ul style="list-style-type: none"> Population ageing (-ve)
Terrones & Otrok (2004)	Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, UK, USA	1970–2003 (yearly), 1980–2004 (quarterly)	Panel DOLS	<ul style="list-style-type: none"> Population growth (+ve) Real disposable income (+ve) Interest rates (-ve) Real credit growth (+ve) Lagged real house prices (+ve)
Tsatsaronis & Zhu (2004)	Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, UK, USA	1970–2003 (quarterly)	Structural VAR	<ul style="list-style-type: none"> General inflation (+ve) Bank credit (+ve) Compression of interest rate spread (+ve) Real interest rates (moderately -ve) Household income (moderately +ve)

According to the European Central Bank (2003, 22), the empirical literature cumulatively suggests that dwelling price movements are foremost affected by “household incomes; interest rates; household formation or other demographic variables; supply side variables; financial market institutions and credit availability; and taxes, subsidies and other public policies directly related to housing”.

Candidate variables for the Composite Index are considered in turn on the following pages. They result from scrutinising the broad literature for variables potentially relevant to the index. Conventional and sub-conventional variables have been considered. The focus is on those that: allow international comparison; apply in the EU context; and have empirically strong predictive power over a long time horizon.

The selection criteria significantly narrow the extensive universe of potential housing price determinants. Even so, an ample suite of candidate variables remains.

2.1 Future economic strength

Economic activity is a significant driver of housing price (e.g. Englund and Ioannides, 1997; Égert and Mihaljek, 2007; Adams and Füss, 2010; Hirata et al., 2012, 131; Takáts, 2012, 137; Karaman Örsal, 2014).

Just as the “economic might of a metropolitan area or region is the primary determinant of the demand for land” (Bourassa et al., 2011, 138), *future* demand is primarily determined by its future economic might.

However, *current* economic strength may poorly reflect *future* strength.

A country’s economic strength varies over time – sometimes “enormously” (Barro and Lee, 1994, 1; Klenow and Rodriguez-Clare, 1997, 73). In examining economic growth rates of 114 countries over thirty years,⁸ Barro (2003) observes no strong correlation between the economic strength of countries and their subsequent economic growth. This reinforces earlier findings – for instance, Barro (1991, 407–408),⁹ and Mankiw et al. (1992, 425).¹⁰

However, when conditionally narrowing the country sample, scholars generally observe a significant, *negative* correlation. That is, countries with higher initial economic strength tend to see that strength decline over time. This is found for example, in the eighty-eight country study of Sala-i-Martin et al. (2004), and the studies of OECD countries by Grier and Tullock (1989, 264–256), Mankiw et al. (1992), and de la Fuente (2003, 656).

Focussing exclusively on EU countries, Crespo-Cuaresma et al. (2008) also document significant, negative correlation between initial and later economic strength. This is consistent with earlier results of Barro et al. (1991) who studied the economic growth of seventy-three regions in seven European countries.

EU membership has grown considerably since the time of these two studies. One may wonder then, whether their findings would still hold for an expanded EU. No study currently addresses this – at least not directly.

However, from Korotayev and Zinkina (2014) it seems reasonable to infer that the negative correlation holds for the expanded EU. Although not specifically considering the Euro area, most EU countries are among those included in the 187 country study.¹¹ It finds, using data from 1981 to 2012 – and drawing from the World Bank (2013) classification of high/middle/low economic income level – a persistently decreasing differential between countries of *high* economic strength relative to those of *moderate* economic strength. Notably, all EU countries – including those few absent from Korotayev and Zinkina’s (2014) panel – fall into one of these two economic strength classifications.

Korotayev and Zinkina (2014, 143) note that if the gap between strong and moderately strong economies continues to shrink at the current pace, convergence will likely occur within fifteen to twenty years. This particular observation is perhaps less valuable for its potential predictive capacity than it is in reinforcing existing knowledge that the speed of convergence can vary over time. (For an example of the historical variation, see for instance, Barro and Sala-i-Martin, 2004, 13).

In summary: economic growth is an important determinant of real estate price growth; current economic strength seems a poor indicator of future economic strength (at least over

⁸ For the period 1965 to 1995.

⁹ Using data from the period 1960 to 1985.

¹⁰ As above.

¹¹ The exceptions are Croatia, Cyprus, Hungary and Malta.

the long-term); and in the EU context, weaker economies will tend to strengthen over time and stronger ones weaken, although the pace of this effect is not consistent over time.

That economic growth is important to price growth does not seem lost on cross-border real estate investors – at least not on professional investors. In her questionnaire study of international real estate investors, Falkenbach's (2009) respondents indicate that a market's expected economic growth highly affects its investment appeal. Although it is beyond the scope of Falkenbach's (2009) study, the finding raises the question as to the basis on which investors have formed expectations about future growth.

In contrast, non-professional housing buyers do not necessarily consider economic growth in their real estate investment decisions. Survey responses of 866 recent buyers in the United States of America indicated "a peculiar lack of interest in objective evidence about fundamentals...[with] price movements...attributed to whatever seems to be the most plausible explanation" (Shiller, 1990, 59[1]).

The economic strength of an economy – that is, its size relative to its population – is typically measured by gross domestic product ("GDP") *per capita*.

Correlation testing indicates a generally moderate to strong correlation between GDP per capita and dwelling price across the panel countries. This is illustrated by the pairs of bar charts and scatter plots of Appendix 1. Some exceptions are apparent, but these are considered not particularly significant overall, noting that they largely coincide with countries for which the time series was unreliably short. Note that because of the variation in time series, the correlation co-efficient "R" values indicated on the charts are not intended to be directly compared against one another.

As summarised in the Table 2.2 on the following page, variants of GDP – though not necessarily per capita GDP – are often included as a criterion in indices considering investment outlook.

From Table 2.2 one can see a tendency to apply GDP – either historical, current or forecast – rather than per capita GDP. So what is essentially being compared there by those indices is the economic *size* of locations rather than their strength. This may be appropriate for their respective purposes – for instance, if they are risk focused. As Chen and Hobbs (2003, 68[7]) explain, "economic size significantly impacts economic risk. Larger economies are usually more capable of withstanding external economic turmoil and are therefore more stable than smaller economies". Also, the size of a country's GDP is an indicator of the size of its real estate market (Higgins, 2005, 532), and as Falkenbach (2009, 304) points out, the size of a real estate market often impacts its liquidity.

Many of the selected indices rely on a measure of *current* economic size/strength rather than anticipated economic size/strength. This is an indicator that they are, at least partially, momentum based. At least in some cases, this seems intentional. For instance, Jones Lang LaSalle's index is named the City *Momentum* Index. Emerging Trends in Real Estate (PWC and Urban Land Institute, 2015, 28) makes price movement forecasts, but only for an annual change to the following year.

Irrespectively, what is required for current purposes is a reliable predictor of *future* growth of output *per head of population*. This is because, over the long-term, the relative economic strength of the relevant EU economies is likely to change, and so too their populations. (Population growth will be discussed later as a separate potential metric).

Table 2.2: Which GPD? The different approaches used by a selection of existing indices

Existing index ¹²	GDP growth (over past period)	GDP	GDP per capita	GDP forecast (over time horizon)	Source of GDP forecast (if applicable)
<i>Real Estate Potential Index</i>				● (5 years)	Global Market Information Database by market data provider Euromonitor International
<i>Global Real Estate Investment Attractiveness Index</i>		●	●		
<i>AT Kearney Real Estate Opportunity Index</i>	● (5 years)				
<i>Hotspots 2025</i>	● (unstated period)	●	●		
<i>Winning in Growth Cities</i>		●			
<i>City Momentum Index</i>	● (unstated period)			● (unstated period)	Unclear ¹³
<i>European Regional Economic Growth Index</i>	● (unstated period)	●		—	
<i>Emerging Trends in Real Estate</i>		●		● (1 year)	Varies by country: relevant Government / Reserve Bank / International Monetary Fund / other unknown

In addition to GDP and per capita GDP, one of the other variables Lieser and Groh (2011) include in their *Global Real Estate Investment Attractiveness Index* is innovation, represented by the *Global Innovation Index* (see Cornell University, INSEAD and WIPO (2015)). Though they do not explain so directly, this variable is associated with future economic strength.

The positive relationship between innovation and economic value has been highlighted by Solow (1957), Romer (1986; 1990) and Lucas (1988) – among others. However, innovativeness, (even if it could reliably be measured), is not necessarily the optimal proxy for future economic growth.

The Composite Index requires not a measure of innovativeness, but a measure of innovativeness *potential*. The difference is perhaps subtle, but important when taking a long-term, future perspective.

Innovation requires knowledge (Gloet and Terziovski, 2004, 402), and some industries and economies are inherently more knowledge-needy than others (Cohen and Levinthal, 1990; Frenken et al., 2007; Boschma and Iammarino, 2009; Hausmann et al., 2014, 7). Complex

¹² As cited in this thesis's introduction.

¹³ A range of data sources used to compile the index are noted, but not to the level of detail allowing identification of the origin of the GDP forecast.

economies – ones that produce relatively diverse, sophisticated and uncommon products – have stronger knowledge appetites. As an apparent consequence, a country's potential to innovate is limited by its economic complexity (Hausmann et al., 2014).

Economic complexity is a new approach to analysing economies. It was first put forward by Hidalgo and Hausmann (2009), and has since been developed/extended by others (for instance: Caldarelli et al., 2012; Tacchella et al., 2012; Christelli et al., 2013; Mariani et al., 2015; Saracco et al., 2015). Whereas GDP measures countries' aggregate productive output, economic complexity reflects the *composition* of that output (Hausmann et al., 2014, 18).

Economic complexity is not merely a correlate, but a fundamental *driver* of economic growth (Hausmann et al., 2014, 27). Accordingly, it is useful in evaluating the economic growth prospects of countries. Those with high economic complexity relative to their current aggregate income have better prospects (Hidalgo and Hausmann, 2009). Put another way, "nations with extensive productive knowledge but relatively little wealth haven't met their potential, and will eventually catch up" (Hausmann, as reported in Mitchell, 2011[5]).

2.2 Future disposable income level, future employment level

Though they diverge significantly on its explanatory power, researchers commonly find a strong, positive correlation between real income and housing price growth.

Using long-term data from the United Kingdom, Holly and Jones (1997) establish real income as the chief single determinant of house prices. Also studying the United Kingdom, Muellbauer and Murphy's (1997) regression analysis shows a significant positive effect of income on metropolitan house prices.

Like findings are made for other European countries – for instance: Germany by Maennig and Dust (2008); Sweden by Hort (1998); and Norway by Jacobsen and Naug (2005). Ott (2014) reinforces the finding across a panel of EU countries, Huynh-Olesen et al. (2013) across its central, eastern, and south-eastern states, and Arestis and González (2014) across OECD countries.

Changes to disposable income levels are likely to be reasonably well reflected by changes in economic strength. The two are so highly related that for practical purposes, they are often treated as equivalent. Borowiecki (2009, 198) notes that in empirical studies analysing the impact of change in real disposable income on dwelling prices, real disposable income is frequently substituted by GDP.

Of course, disposable income at the household level will not reflect merely GDP, but the *distribution* of that aggregate income. Notably, distribution of income per worker varies significantly between EU countries (Eurostat, 2015b).

The handful of relevant existing empirical studies suggest that income distribution affects housing prices. Matlack and Vigdor (2008), Dewilde and Lancee (2013), and Zhang (2016) find that income inequality can boost housing prices.

Conversely, Määttänen and Terviö (2014) find that it tempers price growth. However, they rely on a partial equilibrium model that assumes a fixed number of households, each holding one house. This especially complicates their modelling results, primarily because wealth concentration seems likely to encourage the holding of multiple dwellings (as supplementary homes or investment properties) due to excess capital and/or the status effect.

Irrespectively, the impact of income inequality on housing price appears to be modest compared to other variables, (e.g. Kholodilin and Ulbricht, 2015). This weighs against including income distribution in the Composite Index.

Similarly, there seems no need to include in the Composite Index a separate estimator of future employment levels. It can satisfactorily be captured by a dataset for future economic strength, as in EU countries, growth in per capita GDP and the employment rate are interdependent (Dunford, 1996; Fagerberg et al. 1997). That is, jobs tend to be created as economic strength increases, and lost when economic strength declines.

2.3 Future population growth

As well as contributing to a country's economic growth rate (Kormendi and Meguire, 1985, 157), a growing population creates demand for dwellings and competition for available housing stock.

Not surprisingly then, there is a moderately strong contemporaneous correlation between population and dwelling price. This can be seen in Appendix 2, a series of bar charts and scatter plots to visually illustrate the degree of this correlation. Represented are all panel countries for which the dataset pair provided the fullest time series: 1970 to 2014. "R" values vary, ranging from 0.59 (Sweden), to 0.96 (Belgium).

Relevant econometric studies determine population growth to be a fundamental driver of housing prices.

In their often-cited regression study of house prices in large metropolitan areas in the United States of America, Case and Shiller (1990) find house prices to be sensitive to changes in adult population. So too do others (e.g. Jud and Winkler, 2002). Congruent findings are documented for other major housing markets – for example, Switzerland (by Borowiecki, 2009; Bourassa et al., 2011), and Japan (by Nakamura and Saita, 2007). The relationship also holds for industrialised countries generally (Terrones and Otrok, 2004, 74), for advanced economies (Takáts, 2012; Arestis and González, 2014), for the housing markets of Europe's largest national economies (Ganoulis and Giuliadori, 2011; Algieri, 2013), and for its central, eastern (Égert and Mihaljek, 2007; Huynh-Olesen et al., 2014), and south-eastern countries (Huynh-Olesen et al., 2014).

In contrast, Maennig and Dust (2008) find that population growth does not significantly affect house prices in Germany, yet population decline negatively affects them. However, the observation period is relatively short: 1992 to 2002. Similarly, Jadevicius (2016) does not find Lithuanian house prices to significantly respond to population change. This result may be attributable to the adequacy of the house price index used – it has acute transparency limitations, as described by Jadevicius and Huston (2015, 139).

Population growth comprises natural growth, (that is, birth minus deaths), and net migration.

Approximately thirty-three million people living in the EU were born outside the EU (Eurostat, 2015c). A further seventeen million were born in a different EU country to that in which they reside (Eurostat, 2015c). Together, this represents over ten per cent of the EU's population (based on United Nations, 2015).

The empirical examination by Cvijanovic et al. (2010) suggests that it is only the migration component of population change that impacts housing price, as housing supply tends to well anticipate the demand from natural population growth, but not from migration. Gonzalez and Ortega (2013, 37–38) highlight a striking positive relationship between migration inflows and house prices.

However, it seems premature to dismiss that natural population growth affects housing price, at least in the long-term. Arestis and González (2014) study the housing markets of eighteen OECD countries. Helpfully, they consider both the short and long run relationships of various variables with housing price. Among other things, they find that in the short-term, net immigration is strongly positively correlated with housing prices, whereas natural population growth strongly affects housing prices in the long run.

2.4 Future population age structure

A distinctive demographic trend in the EU is population ageing – the growing proportion of older people (European Commission, 2014a). The intensity of the trend varies significantly between EU countries. For instance, for ten years to year 2014, the proportion of the population sixty-five years old and over grew in Ireland from 11.2% to 12.6%, whilst in Germany it grew double, from 18% to 20.8%, (Eurostat, 2015a).

This is likely to have implications for housing consumption patterns.

The empirical efforts of various scholars indicate that is not merely the size of the population, but its structure – particularly its age distribution – that affects aggregate housing demand (e.g. Campbell, 1963; Ermisch, 1988). Changes in age structure seem to impact housing price (e.g. Mankiew and Weil, 1989, Nishimura, 2011).

Competing conclusions have been reached in the literature regarding the effect of shifts in age structure on housing price, particularly on the weight of their impact.

The scholarly debate remains unsettled. However, from the more recent and more sophisticated empirical analyses it is difficult to avoid the conclusion that population ageing: (a) weakens housing demand (e.g. Ermisch, 1996;¹⁴ Lindh and Malmberg, 2008¹⁵) and (b) deflates housing prices (e.g. Takáts, 2012, Mayer and Gareis, 2013; Saita et al, 2016). Further, over the adult lifetime, a decline in housing demand is likely no earlier than retirement age because each successive generation of the population tends to be healthier and better educated, and therefore has better earnings, or earning capacity, (Eichholtz and Lindenthal, 2014). Eichholtz and Lindenthal consider (2014, 31) that the age to demand relationship they observe in Britain will also likely apply for other European countries, notwithstanding some significant demographic differences. In the same study they also note that, in terms of effect on dwelling prices, the generational income growth effect can be so substantial as to offset population shrinkage. However, one might speculate that the incremental generational improvements to health and education may diminish over the long-term. Together with the already discussed apparent phenomenon of per capita GDP convergence, it is perhaps questionable whether income growth, even lifetime income growth, can be relied on to offset the impact of population aging and population decline on aggregate housing prices.

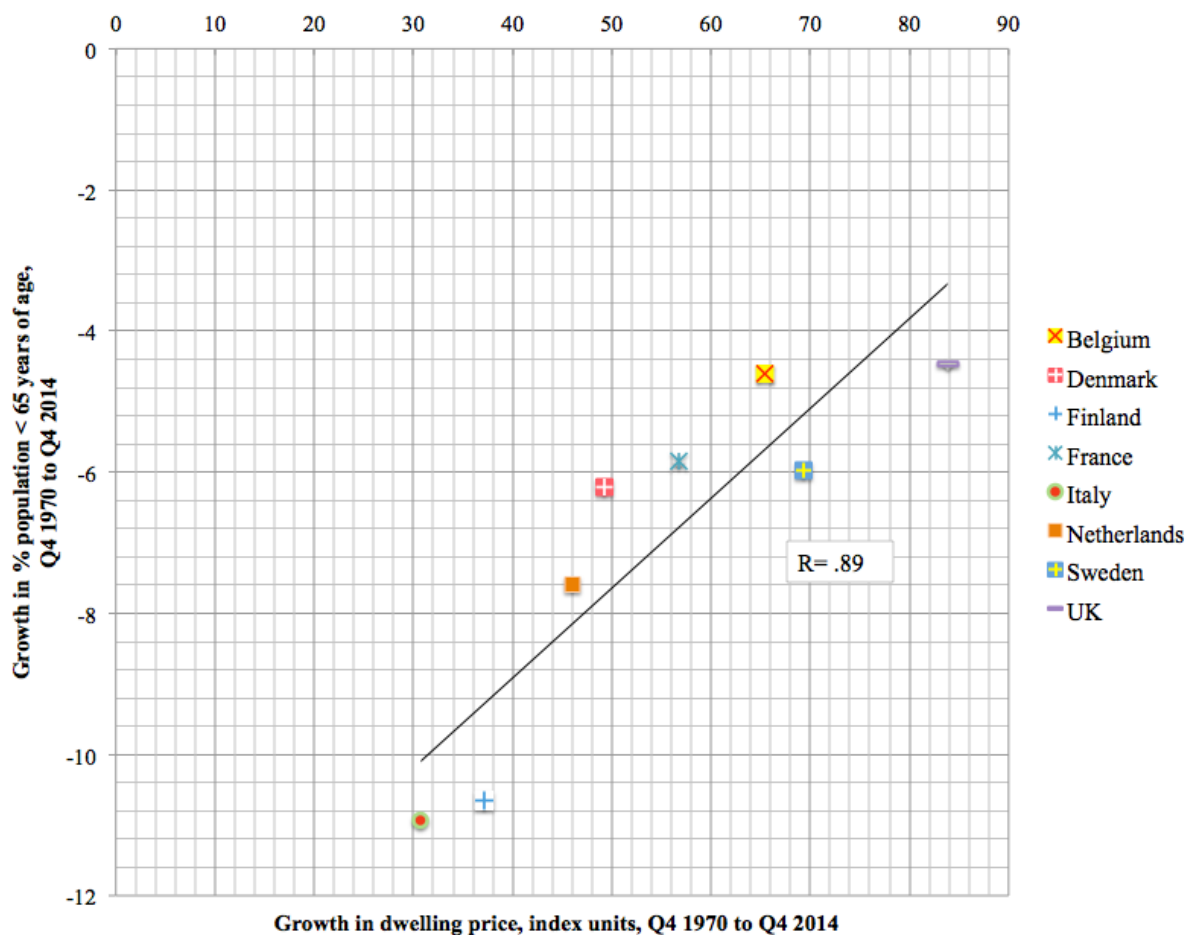
¹⁴ The statistical estimates of Ermish (1996), based on 1989–1990 data from six major cities of England, imply that population ageing shrinks aggregate housing demand.

¹⁵ Lindh & Malmberg (2008) sample Sweden and a cross-country panel of eighteen OECD countries. They find a strong, negative correlation between residential construction and increases in the population of old people. Their time series is significantly long: 1950–1996 for Sweden, and 1964–1995 for OECD countries. Reflecting the classical view, they emphasize that demographic changes will be better reflected in construction volume rather than price, as in the long-run, housing supply is theoretically very elastic.

Figure 2.1 immediately below plots the relationship between dwelling price growth and population youthfulness, as measured by the percentage of the population under sixty-five years of age. The countries represented are the same as in Appendix 2, their selection dictated by time series fullness. A moderately strong positive correlation is evident.

Figure 2.1: Correlation between proportion of population aged below 65 years, and dwelling price growth, for period 1970 to 2014.

Datasets: OECD Analytical House Price Data, real house prices, Q4, (2010=100);
and World Population Prospects (United Nations, 2015), annual total population by
five year age group, estimates 1950–2015.



2.5 Future mortgage growth

As is broadly accepted in the literature, “purchasers of property tend to be exceptionally reliant on external debt finance, while real estate is usually used as collateral in such financing arrangements” (Hördahl and Packer, 2007, 9[5]).

There is very large variation between panel countries in household mortgage levels. Taking extremes, in Denmark outstanding loans represent 237% of annual disposable income, whereas in Romania they represent less than ten per cent (European Mortgage Federation, 2015, 91). This implies that Romania is likely to see greater mortgage growth than Denmark over the long-term, as the Danes, at the aggregate level, have rendered themselves relatively impotent in terms of their capacity to take on more mortgage borrowing.

There is a contemporaneous correlation between housing prices and credit (Hirata et al., 2013, 131), though its strength may vary across countries (e.g. Tsatsaronis and Zhu, 2004; Égert and Mihaljek, 2007), and only large credit movements tend to have a significant impact on housing price (Hirata et al., 2013).

These characteristics seem moderately apparent when the movement of dwelling price is plotted with the movement of the ratio of outstanding residential loans to household disposable income. This can be seen in Appendix 3. It is a somewhat superficial test, and constrained (among other things) by the duration of the time series. That noted, it does provide some support for a tendency of dwelling prices to move with mortgage volumes. Causality though, is another matter. As Annett (2005) explains, “rising mortgage debt may be the result of high prices, not the cause, while any co-movement could reflect a common response to third factors such as interest rates or expected future income growth”.

Deeper investigations are carried out by Mendoza and Terrones (2008), who find that credit tends to lead housing price. Housing price in the German market is shown by Kholodilin and Ulbricht (2015) to be positively impacted by mortgage per capita. In the Irish context, Fitzpatrick and McQuinn (2007, 95–96) find a positive relationship between the dwelling price trajectory and the ratio of mortgage to income. More widely, Gerdesmeier et al. (2015) find the debt to income ratio fundamental to house price movement in Europe. Similarly, mortgage volume is a key driver of European housing prices (e.g. Goodhart and Hofmann, 2008; Ott, 2014), at least in countries experiencing high housing inflation (Égert and Mihaljek, 2007) and in transition economies (Huynh-Olesen et al., 2013).

In terms of the potential impact on aggregate dwelling prices, it is important to distinguish between the credit accessibility and uptake on one hand, and credit *cost* on the other.

The empirical literature addressing the long-run impact of mortgage interest rates on housing prices in Europe suggests that they are co-integrated (e.g. Égert and Mihaljek, 2007; Vizek, 2011), though the weight of current evidence suggests low explanatory power. This observation is collaborated by Ganoulis and Giuliadori (2011, 2671), who note that “[f]or the most part, interest rates (or the user cost of capital) were found [by researchers] to have a statistically significant, though quantifiably limited impact on house prices”.

Ott (2014) shows interest rates to have only marginal impact on Euro area housing price in the long term. Arestis and González (2014) find no significant effect of credit rates on housing price in any of the eleven EU countries studied. Scholars have recognised however, that market sensitivity to interest rates may not only vary across countries (e.g. Kasparova and White, 2001), but also over time – for instance, with financial liberalisation (e.g. Iacoviello and Minetti, 2003). The European Central Bank (2005, 45) notes that the magnitude and structure of households’ existing mortgage debt is likely the critical determinant of sensitivity to interest rate movements.

2.6 Super-normal infrastructure investment

The European Union's suite of Structural and Investment Funds are based on policy to foster economic and structural convergence across the EU by addressing wealth and development disparities.

The spending is channelled to physical and institutional infrastructure programmes that complement those that member states would otherwise deliver.

For 2014 to 2020 alone, the Funds will distribute approximately €450 billion between EU member countries. By design, the allocation of funds across countries is very uneven. This represents a massive redistribution of wealth.

The relevance of this for the Composite Index is primarily that the spending will boost amenity and/or stimulates economic growth, and thereby become capitalised into housing prices.

The majority of the programmes are such that they are likely to have direct and/or indirect positive impacts on housing prices.

For instance, a large portion of the planned spending is on transport infrastructure (see European Commission, 2014). An extensive body of literature examines dwelling price effects of such infrastructure. Recent contributions include Levkovich et al. (2015), who find that the development of highways generally increases housing prices, and Mohammad et al. (2013) who highlight that railway network improvements tend overall to boost housing prices.

As can be seen in the first two columns of Table 2.3 on the following page, Poland receives by far the most generous funding in *absolute* terms. However, from the perspective of likely *impact* to housing prices, the funding is better viewed relative to GDP per capita, or € per head of population, as in the third column of the table below. On this basis, a broader group of “winners” emerges, with Estonia leading the net gain (with a “bonus” of €3,365 for each head of population), but followed reasonably closely by Slovakia, Lithuania and Latvia. On the same basis, the Netherlands receives the least funding, followed closely by the United Kingdom, Denmark and Belgium.

Table 2.3: Whose bonanza? EU regional structural policy funding allocation, 2014–2020.

Country	EU Structural & Investment Funding 2014–2020 (€ M) ¹⁶	Funding per capita ¹⁷
Austria	€5,180	€606
Belgium	€2,877	€255
Bulgaria	€10,015	€1,401
Croatia	€11,187	€2,638
Czech Republic	€24,184	€2,294
Denmark	€1,391	€245
Estonia	€4,417	€3,365
Finland	€3,921	€712
France	€26,350	€409
Germany	€27,672	€343
Greece	€20,107	€1,835
Hungary	€25,400	€2,577
Ireland	€3,526	€752
Italy	€43,790	€732
Latvia	€5,621	€2,852
Lithuania	€8,500	€2,953
Netherlands	€2,113	€125
Poland	€89,039	€2,306
Portugal	€25,915	€2,504
Romania	€31,178	€1,598
Slovakia	€15,898	€2,930
Slovenia	€3,937	€1,904
Spain	€38,012	€824
Sweden	€3,971	€406
United Kingdom	€14,663	€227

Per capita allocated EU regional structural policy funding is included in the Composite Index as a proxy for super-normal infrastructure investment.

¹⁶ Source: European Commission (2014b).

¹⁷ Calculated by the author using year 2015 population data of United Nations (2015).

2.7 Future climate

Climate affects health (see Parker, 1995) and happiness (Frijters and Van Praag, 1998; Rehdanz and Maddison 2005; Brereton et al. 2008; Maddison and Rehdanz 2011; Murray et al. 2013). So perhaps it is of little surprise that a significant body of research indicates that people move in response to geographical variations in climate. As Hoch and Drake (1974, 269) put it, “everybody not only talks about the weather, but does something about it, by taking it into account when making location choices”.

Several empirical studies have confirmed that climate influences population movement within the United States of America. For instance, Rappaport’s (2007) regression modelling shows that since the 1920’s, people have moved to nicer climates, that the phenomenon has accelerated with rising incomes, and that the migration is paralleled by dwelling price growth. Similarly, Chen and Rosenthal (2008) document a persistent preference of households for warm, coastal locations. In his migration study, Graves (1980, 233) describes the explanatory power of climate variables as “impressive”. That householders in the United States of America significantly value a pleasant climate is also seen in the hedonic wage and/or price models of Hoch and Drake (1974), Cragg and Khan (1997), Blomquist et al. (1988), Clark and Cosgrove (1991), Englin 1996, Koirala and Bohara (2014), and Sussman et al. (2014).

National studies of other countries have produced similar results. In Russia, climatic differences foster migration and are reflected in wages (Berger et al., 2008). The hedonic price analysis of Rehdanz and Maddison (2009) implies that within Germany, households prefer warmer and drier climates. Within Italy, households typically prefer drier winters and cooler summers (Maddison and Bigano, 2003), whereas in the United Kingdom climate is such that households are attracted to drier and warmer mid-winters (Maddison, 2001; Rehdanz, 2006) and generally milder, less extreme weather (Meir and Rehdanz, 2016).

Cheshire and Magrini (2006) empirically investigate population growth rates across the European Union, (at that time comprising twelve member states).¹⁸ They find that climate indeed shapes location choice in the EU, but only within countries, not significantly between them. Migrants apparently “chose their country first, but, having chosen their country, they are then influenced by better weather” (at 35).

A competing conclusion is reached by Rodriguez-Pose and Ketterer (2012). Using fresher data¹⁹ and more advanced econometric techniques,²⁰ they find that climatic amenity does shape migration choice between EU countries.

The amenity value of climate may therefore have implications for the relative appeal of EU countries, and by extension, dwelling price growth.

However, because the phenomenon of locating to more pleasant climates appears to be persistent (Rappaport 2007; Chen and Rosenthal 2008), it is likely already captured by population projections. On this basis, to include climatic amenity in the Composite Index would probably “double count” its effect.

What is likely not captured though, is potential migration due to climate *change*.

¹⁸ For years 1980–2000.

¹⁹ Of 133 regions, for years 1990–2006.

²⁰ Specifically, their (static and dynamic) panel data models are regressed based on the Hausman and Taylor (1981) and heteroskedasticity-robust fixed effects techniques.

Continued increases in the levels of anthropogenic greenhouse gases are expected to result in further climate change, likely in the form of an additional increase in mean global temperatures (IPCC, 2013).

If this expectation is realised dwelling prices will be affected. As Kahn (2009, 341) explains, (using the open city model)²¹:

If migration costs are zero, spatially tied attributes such as climate will be capitalized into wages and rents such that the marginal household becomes indifferent about living in a “nice” city as opposed to one with a low quality of life. Climate change is likely to change this spatial equilibrium.

Importantly, dwelling price impact can be expected to vary by location. Mendelsohn (2001, 104) notes: “the marginal value of higher uniform temperatures would not itself be uniform. Places that are already quite hot would actually drop in value. Places that are currently quite cold would increase in value by more than average”.

Spatial sensitivity to climate change can be very significant. For instance, in one of the very few studies modelling the impact of climate change on dwelling prices, Sussman et al. (2014) estimate housing price impact ranging from, at minimum, a 4.4% gain to a 23.4% decline across the counties of the United States of America, and at maximum – based on a similarly plausible, but more severe climate change scenario – a 10.1% gain to a 45.1% decline. The largest declines are estimated in the warm, southern-most counties in California and Florida. Kahn (2009), who uses a somewhat different modelling approach, shows a similar range of sensitivities to climate change across major metropolitan areas of the United States.

One may wonder how dwelling prices in European countries are likely to be impacted by predicted climate change. To date, no known study has addressed this across the EU. However, a number of relevant regional and national level studies have considered impact to household welfare and to economic output. The current generation of these comprise, respectively: Maddison (2003), Rehdanz and Maddison (2005), Maddison and Rehdanz (2011); and Mendelsohn et al. (2000), Hope (2006), Bostelo et al. (2012), Roson and van der Mensbrugghe (2012).

Although these impact studies use different modelling approaches and assume somewhat different climate change scenarios, there is sufficient commonality of results to draw the broad conclusion that, in terms of impact to gross domestic product or household welfare, the anticipated climate change will likely be detrimental to southern Europe but slightly/modestly benefit northern Europe, Russia, and the eastern European former Soviet countries.

The estimated effects of climate change on housing amenity are anticipated to occur over decades rather than single digit years. On balance however, it seems prudent to include climate change as a criterion in the Composite Index because: the effect on price is potentially so significant; this research takes a long-term view; and as cognisance of the phenomenon increases, its anticipated amenity effect is likely to be more or less fully capitalised into housing prices well before those amenity changes are entirely realised.

²¹ Which assumes, among other things, that households are perfectly mobile.

2.8 Corruption

Corruption has been empirically shown to reduce investment and/or retard economic growth (Mauro, 1995; Li, Xu and Zou, 2000; Mo, 2001; Ahlin and Pang, 2008; Swaleheen, 2011).

It occasionally appears as a metric in cross-country comparisons of investment outlook.

One might therefore consider it as appropriate to include in the Composite Index.

There are problems with this.

Firstly, the *effect* of corruption (on investment and growth) varies across countries – often significantly so, (Rock and Bonnett, 2004; Méon and Sekkat, 2005; Méndez and Sepúlveda, 2006; Aidt et al., 2008; Méon and Weill, 2010). Whilst corruption seems generally to stymie growth, it does not necessarily follow that the degree its of impact on economic growth in a less corrupt country is less than the degree of impact in a more corrupt country.

Indeed, corruption may for some countries have a positive impact on growth. Méndez and Sepúlveda (2006) empirically show, that in politically “free” countries, the growth maximising level of corruption is significantly more than zero. Similarly, Swaleheen and Stansel (2007) find that corruption increases growth in economically “free” countries.

Secondly, and as already explained, the Composite Index is concerned with growth prospects of countries, not with their risk profile. Notwithstanding econometric evidence that corruption can (negatively or positively) affect a nation’s economic growth rate, for a potential real estate investor, corruption is fundamentally a risk to variance of potential returns rather than a driver of or constraint to return growth. That is, the pertinent question is “how does the uncertainty contributed by a country’s corruption level affect its risk profile and the required investment risk premium?” rather than, “what will the level of corruption contribute to the return?”

This perspective is akin to that offered by Evrensel (2010). Departing from the substantial body of literature focusing on the empirical relationship between corruption and *growth*, she highlights the relationship between corruption and growth *volatility*. In a more recent contribution, scholars Saastamoinen and Kuosmanen (2014) champion the approach of considering corruption as a source of macro risk – the level of corruption increasing the *variance* of productivity (and by extension, investment and economic growth).

On these bases it seems reasonable to exclude corruption as a potential variable of the Composite Index.

2.9 Latent demand

Household formation is broadly considered to be a key determinant of housing demand.

A peak period for household formation is early adulthood, when adolescents tend to leave their parents’ homes, including for work, romantic relationships, and procreation, (e.g. Billari et al., 2001). This creates significant demand for housing (e.g. Börsch-Supan, 1986, 145; Mankiw and Weil, 1989, 240; Hugo, 2005, 34).

However, this natural demand can be tempered where and when housing is less affordable.

Household formation is sensitive to housing prices (Blanchet and Bonvalet, 1985; Börsch-Supan, 1986), and high housing price has been shown to strongly increase the probability of young adults living with their parents – for example, in Britain (Ermisch, 1999), in Spain (Martínez-Granado and Ruiz-Castillo, 2002), and in Italy (Giannelli and Monfardini, 2003).

As can be seen in the European Community Household Panel survey data (Eurostat, 2015d), there is remarkable variation between EU countries in the proportion of young adults co-habiting with their parents. For example, in Denmark sixteen per cent of young adults (aged eighteen to thirty-four) live with their parents, whereas in Slovakia – the opposite extreme – seventy-four per cent do.

Aside from deferred household formation, there is a sufficient body of literature to reasonably infer that private international remittances are an indicator of latent demand for housing.

Empirical investigations of remittance spending commonly find that remittances are directed to housing. Adams' (2011) review of the household survey literature finds that households receiving remittances tend to spend more at the margin on housing than other expenses. Adams (2006) conjectures that this is likely to impact housing prices. The literature review of the OECD (2007, 154–155) also documents that remittances are often used on real estate.

In his questionnaire study of a migrant group of Ghanaians in Australia, Obeng-Odoom (2010) provides anecdotal evidence that a dominant reason for their remittance transfers is to purchase and construct housing in their home countries.

In a survey of Guatemalan communities, the most common use of remittances was housing (Davis and Lopez-Carr, 2010, 230).

Studying remittances to Georgia, Gerber and Torosyan's (2013) survey finds that remittances tend not to be spent on land, but are spent, among other things, on rent and home improvements. Gerber and Torosyan (2013, 1297) conjecture that remittances also enhance access to loans by improving the savings and creditworthiness of recipients.

The empirical estimations of Stepanyan et al. (2010) suggest that remittances are a significant driver of house prices in countries of the former Union of Soviet Socialist Republics. Ivanauskas et al. (2008, 273) consider incoming remittances of émigrés a driver of housing prices in post-accession Lithuania. Guentcheva et al. (2004, 49) note that remittances have supported the real estate prices in regional Bulgaria. Huynh-Olesen et al. (2013) find that private remittances significantly help explain residential real estate prices in the EU's central, eastern and south-eastern countries between 1999 and 2011.

It may be argued that remittances are likely only a marginal contributor to housing price growth.

However, one should bear in mind that remittance volumes are significant and their net flows concentrated.

For instance, taking recent annual remittance and GDP data of the World Bank (2015a and 2015b respectively), it is observed that the 2013 net inflow of remittances to Lithuania was over one billion euro, equivalent to about 2.6 per cent of its GDP for that year. On the other hand, the Netherlands in the same period saw a net outflow of about seven billion euro, equivalent to almost one per cent of its GDP, or over four hundred euro for each inhabitant. (Remittance income does not appear in a country's GDP, as it is received but not generated there.) Scholars consider official remittance data to be underestimated due to unrecorded flows (Page and Plaza, 2006, 266–268).

2.10 Supply constraints

Housing demand can result in sustained housing price growth only if there is a constraint to additional housing – forcing the market to adjust to the additional demand through price rather than supply expansion.

The constraint could be regulatory, geophysical, or the increase in underlying costs of supply, (e.g. Hsieh, 2012).

The impact of supply constraints depends on the elasticity of the supply. Research suggests that housing supply tends generally to be quite rigid (e.g. Mankiw and Weil, 1989, 247), especially in Europe (Caldera and Johansson, 2013), and that the largest housing price rises tend to occur in locations with the least elastic supply (e.g. Malpezzi and Wachter 2005; Glaeser et al. 2008). Countries vary significantly in long-run price elasticity of housing supply (e.g. Meen, 2002, 8), including those of the EU (Caldera and Johansson, 2013).

The price impact of various supply constraints has been investigated empirically. To date however, no study has to date considered them all together.

For instance, construction costs are documented to have little bearing on supply elasticity (Gyourko and Malloy, 2015, 1290–1291).

Conversely, the presence of restrictive geography – such as mountains and water bodies – is found empirically by Saiz (2010) to be a strong predictor of housing price growth, as such areas tend to be relatively supply-inelastic. Saiz (2010) augments the earlier finding of Rose (1989), who showed that large water bodies have a significant effect on supply elasticity, and who also noted the potential impact of mountains and flood plains.²² Saiz's (2010) and Rose's (1989) research is based on urban areas in the United States, though it seems reasonable to assume that their findings would broadly also apply in the EU. Recently, the empirical investigation of Oikarinen et al. (2015) indicated that geographic constraints significantly increase price elasticity in Finnish cities. Similarly, Hilber and Vermeulen (2016) find that uneven topography increases house prices in England.

Locations with higher population density tend to have less elastic housing supply, and this appears to hold sub-nationally (Green et al. 2005) and also nationally (Caldera and Johansson, 2013, 243–244).

Various scholars have considered the impact of regulation on the price elasticity of real estate. Some key contributions include Malpezzi (1996), Malpezzi and Mayo (1997), Glaeser et al. (2005a; 2005b), and Paciorek (2013). Despite differences in method and measurement, the research broadly indicates a negative relationship between regulation and housing supply elasticity, and generally, a positive relationship between regulation and housing price.

Though it appears potentially relevant, as others (e.g. Quigley and Rosenthal, 2005, 81; Saiz, 2010; Gyourko and Saiz, 2006, 665) have pointed out, housing's regulatory environment is difficult to measure. It is also complex, with at times significant sub-national variation. This is likely to make meaningful cross-national comparisons elusive.²³

2.11 Cyclical undervaluation

Housing prices have a cyclical component (e.g. Borio et al., 1994, esp. 17–19; Wheaton, 1999; Agnello and Schuknecht, 2011; Igan et al., 2011; Hott, 2012; Bracke, 2013; Jadevicius and Parsa, 2014; Ciarlone, 2015; Eichholtz et al., 2015). That is, they fluctuate from the trend

²² Rose's study builds upon the earlier regression analyses of Muth (1969) and Ozanne & Thibodeau (1983), which both account for geographic constraints.

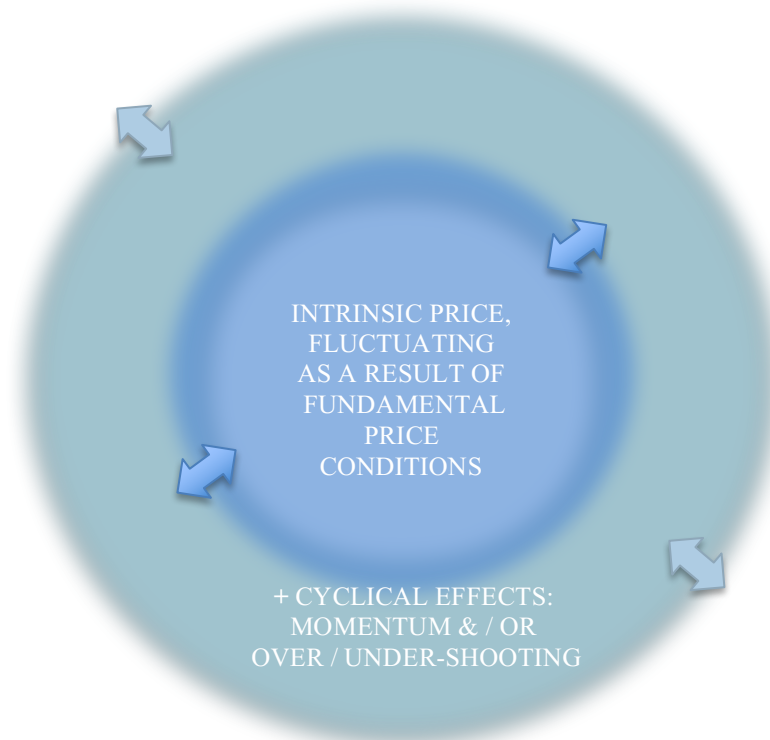
²³ A further complication is that dwelling price tends to increase with the restrictiveness of regulation, but not necessarily does its land component (see Ihlanfeldt, 2007).

implied by the long-run determinants of price. The dynamic joint contribution to price of its fundamental and cyclical components are visually conceptualised in Figure 2.2 below.

Commonly used ratios for estimating the historical long-run price of housing are price-to-wages, price-to-rent, and price-to-cost of construction, (Mayer, 2011, 566–570), though the latter ratio is seldom applied in the literature.

Depending on one's theoretical perspective, deviation from the long-run level is due to: supply rigidity resulting in price overshooting on market shocks; (and)/or self-fulfilling, backward looking expectations about future price.²⁴ The former interpretation is evident in Poterba (1984), and Bessone et al. (2005, 10), for instance. The latter is observable in Case and Shiller (1989), Abraham and Hendershott (1996), Malpezzi and Wachter (2005), Antipa and Lecat (2010), Burnside et al. (2015), and Ling et al. (2015), among others.

Figure 2.2: Housing price over time – fundamental and cyclical components



Source: author's composition

The duration and amplitude of housing price cycles are irregular, and can vary significantly by time and location, (e.g. Muellbauer, 1994; Meese and Wallace, 2003, 1039; Cunningham and Kolet, 2011; Bracke, 2013, see esp. 218).

That said, prices tend to follow a pronounced pattern of several years of expansion, followed by contraction (Englund and Ioannides, 1997, 120[1]). The contraction can last many years (e.g. Abraham and Hendershott, 1996, 205), even decades (Ambrose et al., 2013), especially following a long period of expansion (Bénétrix et al., 2012; Bracke, 2013). Relatedly, Mikhed and Zemčík (2009) establish that reversion to the implied long-run price can take decades.

²⁴ This distinction is also noted by Hort (1998, 93–94), and similarly by Glindro et al. (2011).

Alvarez et al. (2010), Ferrara and Koopman (2010) and Vansteenkiste and Hiebert (2011) show European countries exhibit weak co-movement in housing price cycles, despite strong linkages in their economic cycles.

The importance of cycles to the Composite Index is that the potential for housing price growth is affected by the deviation of current prices from the trend implied by their long-run determinants of price. All other things being equal, a national housing market whose prices are below long-run levels has more potential for appreciation (over the long-term) than one whose prices are above the long-run level. At any point in time, each EU country's housing market will have a relative advantage/disadvantage in long-term price growth simply because of its cyclical divergence.

2.12 Other

There are other factors that may affect country-level, aggregate housing prices. However, for various reasons they are considered not applicable or of low relevance to the Composite Index.

For instance, empirical findings suggest that movement in equities markets can influence the price of residential real estate – through its “wealth effect” increasing demand (e.g. Sutton, 2002, 50; Kakes and van den End, 2004; Algieri, 2013), and/or as an investment alternative (e.g. Kapopoulos and Siokis, 2005, 128; Gounopoulos et al., 2012). However, aggregate holding of equities is vastly different across EU countries. Further, the direction of the correlation between housing prices and equity prices varies. This is documented by Égert and Mihaljek (2007), for example. They find a negative correlation in OECD countries, but a positive correlation in central and eastern European countries.

The author is also wary of “over-parameterisation”, especially as a stated objective of the research is to put forward a *simple* model.

3 Components of the Composite Index

As has been considered, various candidate variables seem to contribute significantly to future housing price growth. Others either do not, or to include them would lead to double counting.

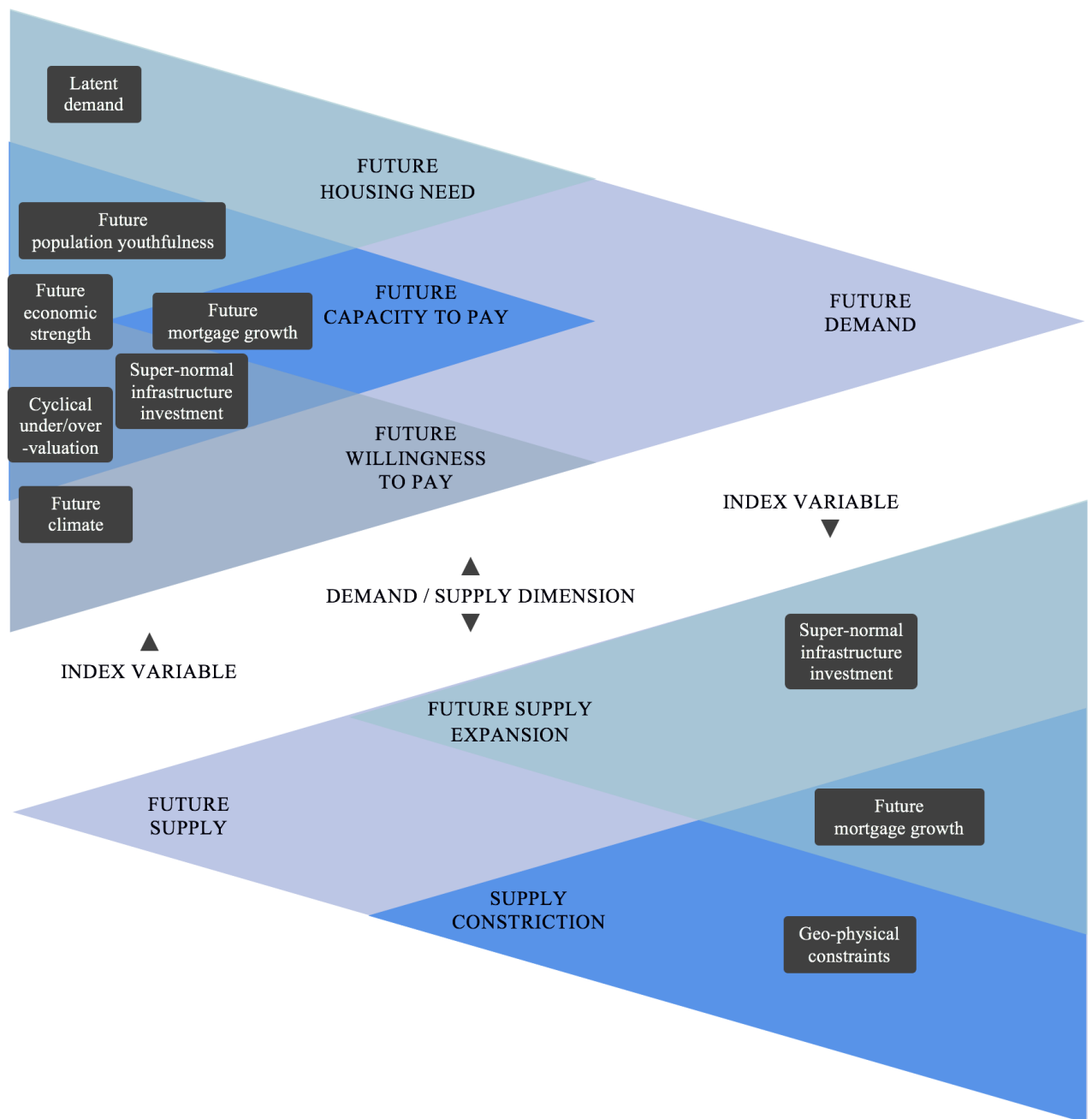
Based on the review of the literature, the factors considered most applicable to the Composite Index are: future economic strength; future population growth; future population youthfulness; future credit growth; super-normal infrastructure investment; future climate; latent demand; supply inelasticity; and adjustment for cyclical under/over-valuation.

These factors are somewhat inter-related in terms of their contribution to housing price movement. This is reflected in the Figure 3.1 on the following page.

For instance, future economic strength falls within the “capacity to pay” dimension of demand. This is because a strengthening economy increases spending power – by tending to boost not only disposable income, but also credit capacity (Almeida et al., 2006). However, it also occupies the “housing need” dimension because for instance, economic conditions impact population levels – by affecting the birth rate (e.g. Goldstein et al., 2013) and migration (e.g. Mayda, 2010). Likewise, future economic strength also contributes to “willingness to pay”, as it affects expectations about housing price growth (Jacobsen and Naug, 2005, 32–33).

Similarly, future mortgage growth appears not only as a demand determinant, but also as a supply determinant, as it impacts a developer/builder’s capacity to commence construction (e.g. Sai-Fan Chan, 1999; Ambrose and Peek, 2008).

Figure 3.1: Variables as selected, from a demand / supply perspective



Source: author's composition

4 Construction of the Composite Index

4.1 Proxy datasets

The quantitative indicators used to compare countries based on the relevant factors are listed in Table 4.1 below. It is followed by explanatory comments about the choice of proxy datasets.

Table 4.1: Which datasets?

Driver of future price growth	Proxy	Source
Future economic strength	Expected average growth in per capita GDP, 2014–2024.	<i>The Atlas of Economic Complexity</i> (Centre for International Development at Harvard University, 2015).
Future population growth (including net immigration)	Average annual rate of population change, 2015–2030, medium fertility variant.	World Population Prospects (United Nations, 2015).
Future population youthfulness	Projection of persons aged 65 & over, % change 2020–2060.	<i>Europop 2013</i> (Eurostat 2014).
Future mortgage growth	Ratio of total outstanding residential loans to disposable income, as at end of 2014. ²⁵	<i>Hypostat 2015</i> (European Mortgage Federation, 2015).
Super-normal infrastructure investment	European Union Structural Investment Funding, 2014–2020, per head of population, as at 2015.	European Commission (2014b), and United Nations (2015), respectively.
Future climate	Market impacts as a percent of GDP for a 2°C warming by 2100, reduced-form mode.	Mendelsohn et al. (2000, 565).
Latent demand – household conditions	Share of young adults aged 18–34 living with parents, year 2013, weighted by: “Individualism” cultural dimension, and Dwelling overcrowding rate, year 2014.	Eurostat Statistics – Income & Living Conditions series (Eurostat, 2015d), and Hofstede et al. (2010), and Eurostat (2015e) – Income and Living Condition Series, respectively.
Latent demand – net remittances	Net remittance inflows, year 2013.	World Bank (2015a) Annual Remittance Data.
Supply inelasticity	Mountain area as a percentage of total area, and water and wetlands as a percentage of total area.	Nordic Centre for Spatial Development (Nordregio, 2004), and Eurostat (2013), respectively.
Cyclical undervaluation	Price to Income Ratio (Q2 2015). ^{26 27}	OECD Analytical House Price Database. ²⁸

²⁵ Or where not available, the most recently available year end, (being 2013 for Lithuania).

²⁶ Or where not available, the most recently available period, (being Q1 2015 for Germany, and Q4 2014 for Belgium).

²⁷ Poland, sourced from a related dataset, uses year 2014. See footnote 28 below.

²⁸ Except for Poland, which due to lack of data was sourced from European Mortgage Federation (2015, 102), adjusted to reflect the differences in the base year.

The Composite Index applies the economic complexity framework to anticipate future economic strength. Specifically, the proxy adopted is the expected average growth in per capita GDP from the *Atlas of Economic Complexity*, as released Harvard University's Centre for International Development. Growth projections of each year from 2004 to 2014 have been published. The Composite Index relies on the 2014 projection, which has a nominal ten year horizon (i.e. to year 2024). The growth projection of the *Atlas of Economic Complexity* is based on the misalignment of a country's GDP per capita with their level of economic complexity (Hausmann et al., 2014, 85). Economic complexity is more predictive of a country's economic growth than other standard measures – including the *Global Competitiveness Index* (see World Economic Forum, 2015), education, governance, and institutional quality, (Hausmann et al., 2014).

In an attempt to reflect the differences in future population growth of EU countries, the Composite Index incorporates a population forecast from an authoritative source – United Nations' *World Population Prospects*. The forecasting accuracy of this biennial series has been found to be sound (Keilman, 1998). The current revision is used. Although it includes projections up to year 2100, the projection period to 2030 is adopted. This better correlates with the assumed (minimum) time horizon of the Composite Index, and is likely to be more reliable than a longer-range projection. The literature confirms that the accuracy of population forecasts decline with forecast duration (Keilman, 2008, 137).

The Composite Index recognises that these future populations may age differently. It measures relative youthfulness of population from the inverse proportion of the projected growth of retirement age population, as obtained from Eurostat's most recently published (Europop 2013) projected change in percentage of the population aged 65 years old and over for the period 2020 to 2060.

The Composite Index also includes a variable to reflect potential mortgage credit expansion – the ratio of outstanding residential loans to household disposable income. The source is *Hypostat 2015*, the annual statistical report of the European Mortgage Federation.

As a proxy for extraordinary infrastructure spending, country data from the European Union Structural Investment Funding allocation for 2014–2020 is divided by per country population, sourced from the United Nations (2015) *World Population Prospects*.

To take into account future climate the Composite Index relies on data from a chart in Mendelsohn (2000), the only known source estimating relevant impact at a country level for the panel countries.

Latent demand is assessed in two ways. The first is a social indicator – deferred household formation. Young adults cohabiting with parents are taken to be potential consumers of housing once affordability improves, and the weight of potential demand a powerful support for future price. However, not only does high housing price deter young adults from living away from their parents, so to do does “a larger and less crowded parental house” (Angelini and Laferrère, 2013, 394[3]). The Composite Index therefore uses household overcrowding data to weight the parental co-residence data (by simple multiplication) in order to reflect that young adults living with their parents in more crowded circumstances likely reflects greater latent demand than does that of their counterparts in other countries living at home in more comfortable circumstances. Overcrowding data is obtained from Eurostat's annual *Income and Living Condition Series*. Also, the sub-index incorporates a cultural perspective. It takes into account that it is more socially acceptable in some EU countries for young adults to be living with their parents, and less so in others. The underlying assumption is that is that co-habiting with their parents in a country where it is less socially acceptable is likely a stronger indicator of latent demand than the same in a country where it is more acceptable. This is supported by existing research. Cultural differences significantly influence patterns

of young adults co-residing with their parents (Giuliano, 2007; Skovgaard Nielsen, 2015), and shape normative expectations about the appropriateness of such arrangements. Accordingly, the living with parents data is weighted (by simple multiplication) with a proxy for the national social acceptability of such a situation – collectivism. Individualism–Collectivism is a long-established (Triandis, 1995; Kagitçibasi, 1980, 3–8) sociological dimension. By far the most influential definition of it is advanced by Hofstede (1980, 51):–

Individualism pertains to societies in which the ties between individuals are loose; everyone is expected to look after himself or herself and his or her immediate family. Collectivism as its opposite pertains to societies in which people from birth onwards are integrated into strong, cohesive ingroups, which throughout people's lifetime continue to protect them in exchange for unquestioning loyalty.

Hofstede (1980) originated a scale to measure this sociological dimension, as well as three other dimensions, across cultures. Classification of countries according to the Individualism–Collectivism dimension is not without detractors. (For a review of the critical literature see Voronov and Singer (2002).) Nonetheless, this measurement is commonly applied in academic research (Bakir et al., 2014, 226[3]), and is considered appropriate for present purposes.

Private international remittances are also taken to be an indicator of latent housing demand. Net private remittance receipts are calculated from World Bank (2015a).

The Composite Index attempts to address supply constraint differences between countries with measures of restrictiveness of geography. A country's coverage by mountains is sourced from Nordic Centre for Spatial Development (Nordregio, 2004), and its coverage by water bodies is sourced from Eurostat's (2013) *Land Cover 2012*. The Composite Index recognises existing cyclical over-valuation as a handicap to growth potential, and under-valuation as an advantage for future growth. To do so it relies on a measure of the current divergence between national housing prices and their own long-run relationship with income. Essentially, what is being compared is not each country's relative dwelling affordability, but its relative dwelling affordability compared to the historical average of that affordability. This can be seen in the penultimate column of Appendix 5, in which a value of 100 represents the long term historical average, and the final column, which represents the deviation from this average. The calculations for this rely on ratios of price to income from the OECD *Analytical House Price Database*. The ratio divides index nominal dwelling prices by nominal disposable income per head of population. The OECD's database in turn derives dwelling prices from the constant quality *Residential Property Price Indices* series of national dwelling sales,^{29 30} the data for which is sourced from the statistical offices of the European Commission, the statistical offices of relevant national governments, and relevant national central banks. It is considered valuable to also include a supplementary measure of cyclical over/under-valuation – based on the ratio of dwelling prices to rent prices. However, no authoritative dataset has been identified that covers a sufficient quantity of EU countries.

²⁹ The exception is for Greece, for which the constant quality Residential Property Price Index applied is based on total stock, rather than sales.

³⁰ Dwelling sales include both newly-built and existing residential dwellings, except for Belgium, for which only existing dwellings are included. Like the discordance noted in 29 above, this is considered immaterial to the results of the present index.

4.2 Normalisation

Between datasets representing each variable there are different units of measurement, and wide variation in the range of values.

To allow for comparison and aggregation of variables, the raw data values for each proxy are re-scaled to a range of zero to one hundred; (zero to fifty for each of the proxy pairs of the supply constraint and latent demand variables). That is, for each variable, the country with the lowest raw value scores zero (most unfavourable for price growth), the country with the highest raw value scores one hundred (most favourable for price growth).

This prevents variables with the broadest range of data values to dominate the Composite Index.

An outcome of this treatment is to emphasise differences between countries in their price growth drivers. A danger of course, is that the re-scaling can exaggerate particular differences between countries that in the base data are minor or insignificant. The reader should bear this in mind.

It would also be prudent to bear in mind potential variation between proxies in the uncertainty of their ability to reflect the intended variable.

For transparency, and to foster replication, the raw data used to construct the Composite Index is appended – as Appendix 5.

4.3 Weighting

For simplicity a neutral weighting of the criteria has been adopted. That is, each contributes equally to the Composite Index. This can be seen in Table 4.2 immediately below.

Table 4.2: Relative weighting of Composite Index variables

Variable	Relative weight	Nominal weight	Total nominal weight
Future economic strength	1	100	100
Future population growth	1	100	100
Future population youthfulness	1	100	100
Future mortgage growth	1	100	100
Super-normal infrastructure investment	1	100	100
Future climate	1	100	100
Latent demand	1		100
Household conditions		50	
Net remittances		50	
Supply inelasticity	1		100
Geophysical constraint – mountains		50	
Geophysical constraint – water bodies		50	
Cyclical undervaluation	1	100	100

This is an arbitrary, but nonetheless plausible weighting.

An alternative to this “naïve” approach is to draw the weighting from the body of existing knowledge. Unfortunately, the literature provides little clarity on the relative *importance* of factors contributing to housing price growth. As pointed out by Borowiecki (2009, 198[3]):

[t]here is broad coherence among researchers when it comes to distinguishing the direction of impact of each house price determinant and the signs corresponding to economic theory. However, when it comes to distinguishing the explanatory power or size of parameters, there seems to be little agreement.

Others make the same observation. For instance, it is echoed by Algieri (2013, 319[3]):–

Although there is a broad consensus among researchers regarding the direction of the impact of each house price determinant, there is less agreement regarding the size, the explanatory power, and the relative explanatory importance of the variables.

To deal with this uncertainty, a propensity approach was considered. That is, weighting the Composite Index variables based upon the relative frequency they appear in the empirical literature as a relevant determinant of housing price. However, the approach would in this instance introduce unacceptable bias. Not only have empirical studies tended to test a narrower range of variables than the suite of factors proposed by this Composite Index, but the relevant body of knowledge continues to significantly evolve, so irrespective of their potential merit, some factors (e.g. population ageing, climate change) have to date received far less attention than others (e.g. population growth, household disposable income).

Another alternative is to use regression techniques. The regressions would test for explanatory power with a time lag of at least ten years. However, this is hindered by an insufficiently long time series of data, especially for the transition economies. Further, the low number of potential observations are complicated, and somewhat undermined, by “transition effects”. The panel’s transition economies of the Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Slovakia and Slovenia – only joined the EU twelve years ago. This accession, and the transition process leading up to it introduced “one-off” structural, institutional and expectation changes. These fundamentally affected the trajectory (and growth potential) of dwelling prices in those countries, and contributed to price volatility (e.g. Égert and Mihaljek, 2007; Danevics and Hansen, 2010, 16; Lux and Sunega, 2010, 101–109; Huynh-Olesen et al., 2013; Vandenbussche et al., 2015; Wrobel, 2015, 13–14). Although price development varied across the countries (e.g. Vandenbussche et al., 2015, 348–349), it was generally very pronounced (Huynh-Olesen et al., 2013, 54; Carlione, 2015, 20). Vandenbussche et al. (2015, 344) declare the amplitude of the housing cycle in many transition countries as “spectacular” during that era, especially the Baltics. For instance, from years 2001 to 2007, de-inflated dwelling prices in Lithuania grew an average of 20% annually, then fell an average of 18% annually for the next five years, (as calculated from BIS, 2016). Danevics and Hansen (2010, 16) describe the housing market movement in post-accession Riga, noting very strong price escalation, followed by, “one of the largest (arguably, the largest) property crashes that the world has ever seen”.

5 Results and discussion

The Composite Index outcome is represented on the pages immediately following – in the bar chart of Figure 5.1, and the scoring and ranking of Table 5.1. In each case, the greater the cumulative score, the higher the modelled long-term potential for housing price growth.

The results indicate the long term housing inflation potential of each country, in comparison to the others.

They also indicate much variation between countries at the component level. For discussion purposes, the results are first considered at that level. This is assisted by the box plots of Figure 5.2, which illustrate the distribution, shape and central tendency of the component scores.

For future economic strength one observes a concentration of high scores, which is also reflected in the underlying data, as provided in Appendix 5. This makes more conspicuous the score of Germany, which deviates very significantly from all other countries. Its low score suggests relatively poor long-term potential to grow its per capita GDP. Although its economic complexity is high, so too its existing economic strength. That is, the economic strength potential afforded by its economic complexity has already been maximised. Austria and Italy also stand out for their low scores, though not to the same degree as Germany. Normalisation of the underlying data seems to have minimal impact on the results for this component.

Far less concentrated are the scores for future population growth. Here, particularly high scorers are Ireland, Sweden and the United Kingdom. Conversely, Latvia and Lithuania are the lowest scorers. The underlying data forecasts that they will experience significant population losses over the selected period. In the proxy dataset the range of values is large. This minimises the distortive impact of normalisation. A separate matter is the level of forecast certainty. A key issue here is that the population projections assume persistent economic and social progress, so their accuracy are particularly sensitive to unanticipated trends (Keilman, 1998, 37[4]). A topical example of such a trend is a new influx of migrants and refugees.

Although Lithuania and Latvia show relatively low prospects of long-term population growth, they stand out as being the least prone to growth in their proportion of retirement age population. In comparison, Ireland is one of the most prone to growth in the percentage of this age group, and also has the greatest potential for overall population growth. Again, the broad range of values in the underlying data minimises the impact of normalisation.

Like future economic strength, the future credit growth scores are generally high. That is, most panel countries appear to have relatively strong capacity for long-term mortgage expansion. Those that do not are Denmark, the Netherlands, and to a lesser degree, Sweden. As can be seen in Appendix 5, the range of values in the proxy data is broad.

Likewise, the span of values in the metric for super-normal infrastructure is wide. The distribution of the scores for this component are very positively skewed – the average score is approximately forty, whilst the median score is approximately twenty. This re-highlights that a minority of the panel countries benefit especially well from the wealth redistribution programme.

Figure 5.1: Long-term growth prospects of aggregate housing price growth – country comparison

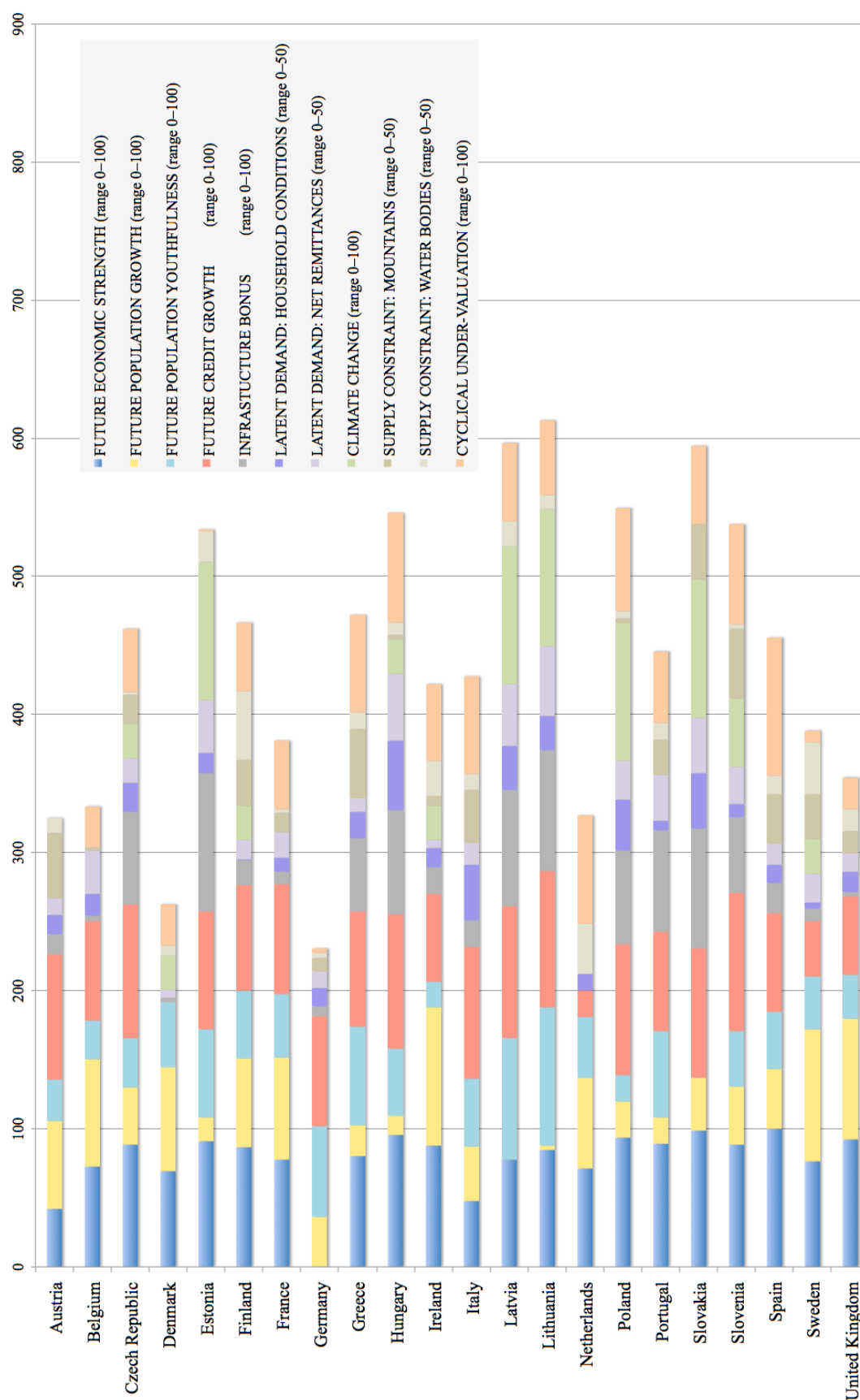
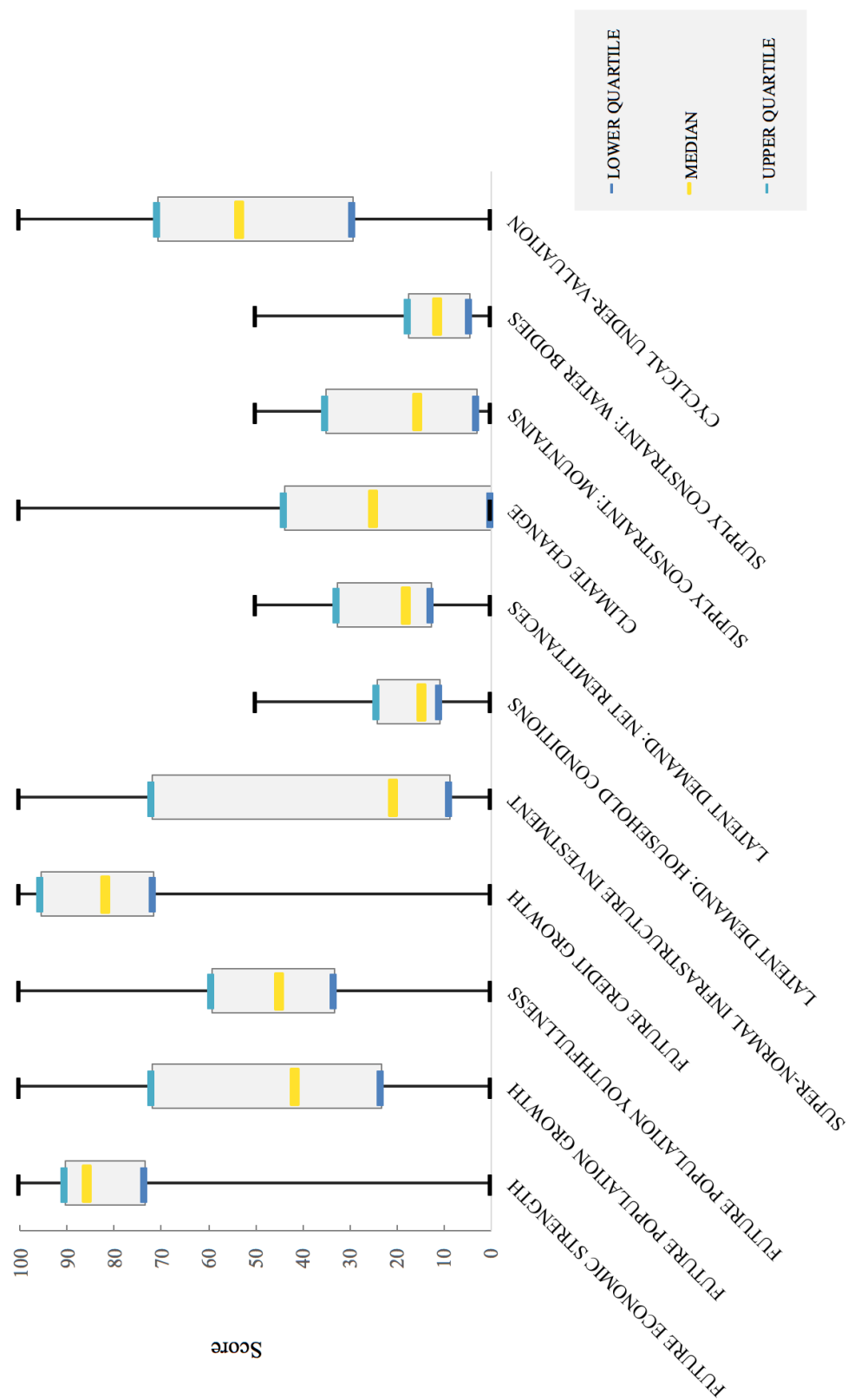


Table 5.1: Ranking, including component scores

COUNTRY	FUTURE ECONOMIC STRENGTH (range 0–100)	FUTURE POPULATION GROWTH (range 0–100)	FUTURE POPULATION YOUTHFULNESS (range 0–100)	FUTURE CREDIT GROWTH (range 0–100)	INFRASTRUCTURE BONUS (range 0–100)	LATENT DEMAND: HOUSEHOLD CONDITIONS (range 0–50)	LATENT DEMAND: NET REMITTANCES (range 0–50)	CLIMATE CHANGE (range 0–100)	SUPPLY CONSTRAINT: MOUNTAINS (range 0–50)	SUPPLY CONSTRAINT: WATER BODIES (range 0–50)	CYCLICAL UNDER- VALUATION (range 0–100)	TOTAL SCORE (theoretical max. 900)	OVERALL RANK
Austria	42	63	30	90	15	14	12	0	47	11	0	325	20
Belgium	73	78	28	72	4	16	31	0	3	0	29	333	18
Czech Republic	89	41	36	96	67	21	18	25	21	2	46	462	10
Denmark	69	75	47	0	4	0	6	25	0	7	30	263	21
Estonia	91	17	64	86	100	15	38	100	0	22	1	534	7
Finland	87	64	49	77	18	1	14	25	33	50	50	467	9
France	78	74	46	80	9	10	18	0	14	2	50	381	16
Germany	0	36	65	80	7	13	12	0	9	4	3	231	22
Greece	80	22	71	84	53	19	10	0	50	12	70	472	8
Hungary	96	14	48	97	76	50	49	25	3	9	80	546	5
Ireland	88	100	19	63	19	14	6	25	7	26	56	422	14
Italy	48	39	49	96	19	40	16	0	39	11	71	428	13
Latvia	77	0	88	96	84	31	45	100	0	18	57	597	2
Lithuania	85	3	100	99	87	25	50	100	0	10	54	613	1
Netherlands	71	66	44	19	0	12	0	0	0	36	79	327	19
Poland	94	26	19	95	67	37	28	100	3	5	75	550	4
Portugal	89	19	62	72	73	7	33	0	25	12	52	446	12
Slovakia	99	38	0	93	87	40	41	100	40	0	57	595	3
Slovenia	89	42	40	100	55	9	27	50	50	3	72	538	6
Spain	100	43	42	71	22	13	15	0	36	14	100	456	11
Sweden	77	96	38	40	9	5	21	25	32	38	9	388	15
United Kingdom	92	87	32	57	3	15	13	0	16	16	23	355	17

Figure 5.2: Box plot of component scores



As already discussed, the latent demand component of the index has two sub-components. The first aims to measure the built up pressure for household formation by young adults. The Composite Index suggests that such pressure is currently least in Denmark, Finland, Sweden and Portugal, and most in Hungary, Italy and Slovakia. The reader is reminded that the sub-category scores here are the result of adjusting the young adults living with parents data with a measure of cultural individualism and of overcrowding, (in equal proportions). This treatment seems intuitively sound. However, the scoring is sensitive to it, primarily for those countries with especially low or high levels of individualism or overcrowding. For instance, and as can be seen in Appendix 5, Portugal has one of the highest proportions of young adults co-habiting with parents, yet the lowest level of individualism. Also, in the base data for young adults co-habiting with their parents, the range is only moderately wide. As a consequence, the differences between countries, as reflected in their normalised scores, are likely more exaggerated than for other components of the Composite Index.

Based on net, private, international remittance receipts per capita as a signal of latent demand, Lithuania, Hungary and Latvia are the highest scorers. The Netherlands, Ireland and Denmark are the lowest.

No obvious relationship is observed between countries' respective scores for the co-measures of latent demand. That is, how a country scores under one does seem to noticeably affect how it scores under the other.

For the future climate change component of the Composite Index the majority of countries score low. The high scoring countries are Estonia, Latvia, Lithuania, Poland and Slovakia. In the base data the increments of differentiation between countries is large, and this is reflected in the Composite Index scores for this category. Thus the only scores observed are zero, twenty-five, fifty or one hundred. It is possible that these large increments have a minor influence on ultimate ranking under the Composite Index.

Turning now to the supply constraints component, it is observed that countries scoring high for mountain coverage do not necessarily score high for water body coverage. Indeed a mild opposite trend seems apparent. This confirms the importance of including in the model both measures of geographic supply constraint, as they seem to be complementary rather than substitutes. The interquartile range for water body coverage is significantly smaller than for mountain coverage, highlighting that the range of the bulk of scores for water body coverage is smaller.

Based on the measure used for cyclical undervaluation, Spain is the relatively most undervalued, and Austria, Estonia, Germany and Sweden the least undervalued.

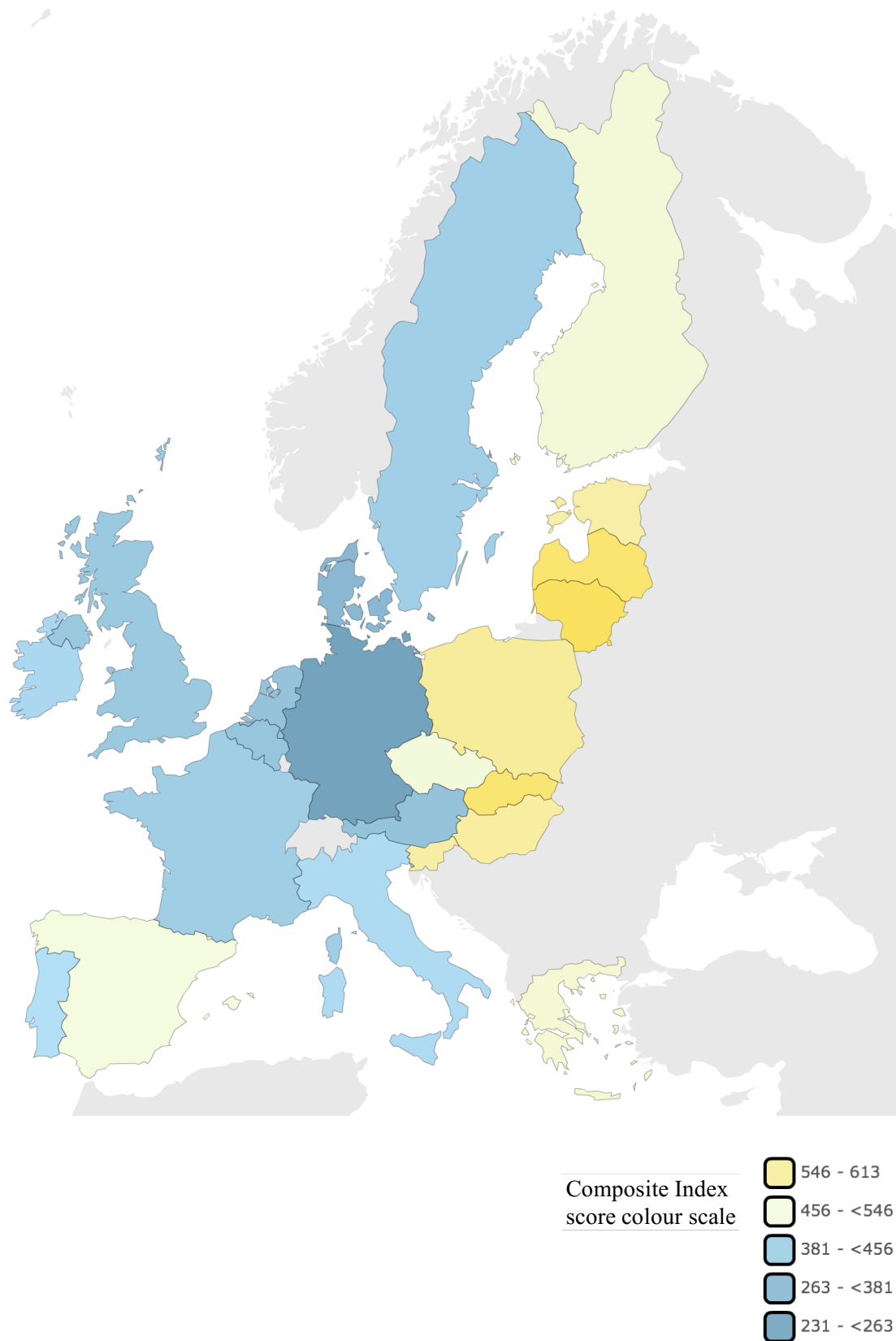
At the composite level, the model indicates that Lithuania offers the best prospect for long-term housing inflation. Very close behind Latvia and Slovakia score nearly equally, followed by Poland, Hungary, Slovenia and Estonia, which score very similarly. The lowest scoring country is Germany, with only about a third of the score of Lithuania (the top scorer).

Like Germany, none of the other countries with large economies rank particularly high. The United Kingdom for instance, ranks only seventeenth, France sixteenth, Italy thirteenth, Spain eleventh, and the Netherlands nineteenth.

A spatial representation of the results of the Composite Index is represented in the Figure 5.3 on the following page. In terms of country geographical groupings, the panel's Baltic countries are the clear overall leaders. They rank relatively strongly on several factors: youthfulness of future population, infrastructure bonus, climate change, and net remittances. Conversely, of all the countries they rank worst in future population growth.

The east-central and south-east European countries score moderately strongly.

Figure 5.3: Results from a spatial perspective



Of the panel's Nordic countries, Finland ranks highest, particularly because of a more favourable deviation in its price to income ratio, and its greater potential for mortgage growth.

More generally, the large difference in total scores across the sample is noteworthy, and an indicator that broadly, the results are not particularly sensitive to weighting.

Also noteworthy is that every country ranked in the top ten tends to be considered (or has tended in recent years to be considered) part of “peripheral” or of “emerging” Europe, (e.g. Melander et al., 2011, 354), including by international real estate investors (e.g. Haran et al., 2016). In terms of index composition, this particular outcome seems most influenced by the inclusion of three variables: economic strength potential (and not existing economic strength); infrastructure bonus; and the impact of future climate. The high ranked countries tend to score especially strongly in all three of these areas.

The results of the study have implications for future household wealth and the relative cost of living between EU countries. They also have investment selection implications. For instance – at the household level – the merits of renting versus buying. Or for the international investor, which national market to invest in.

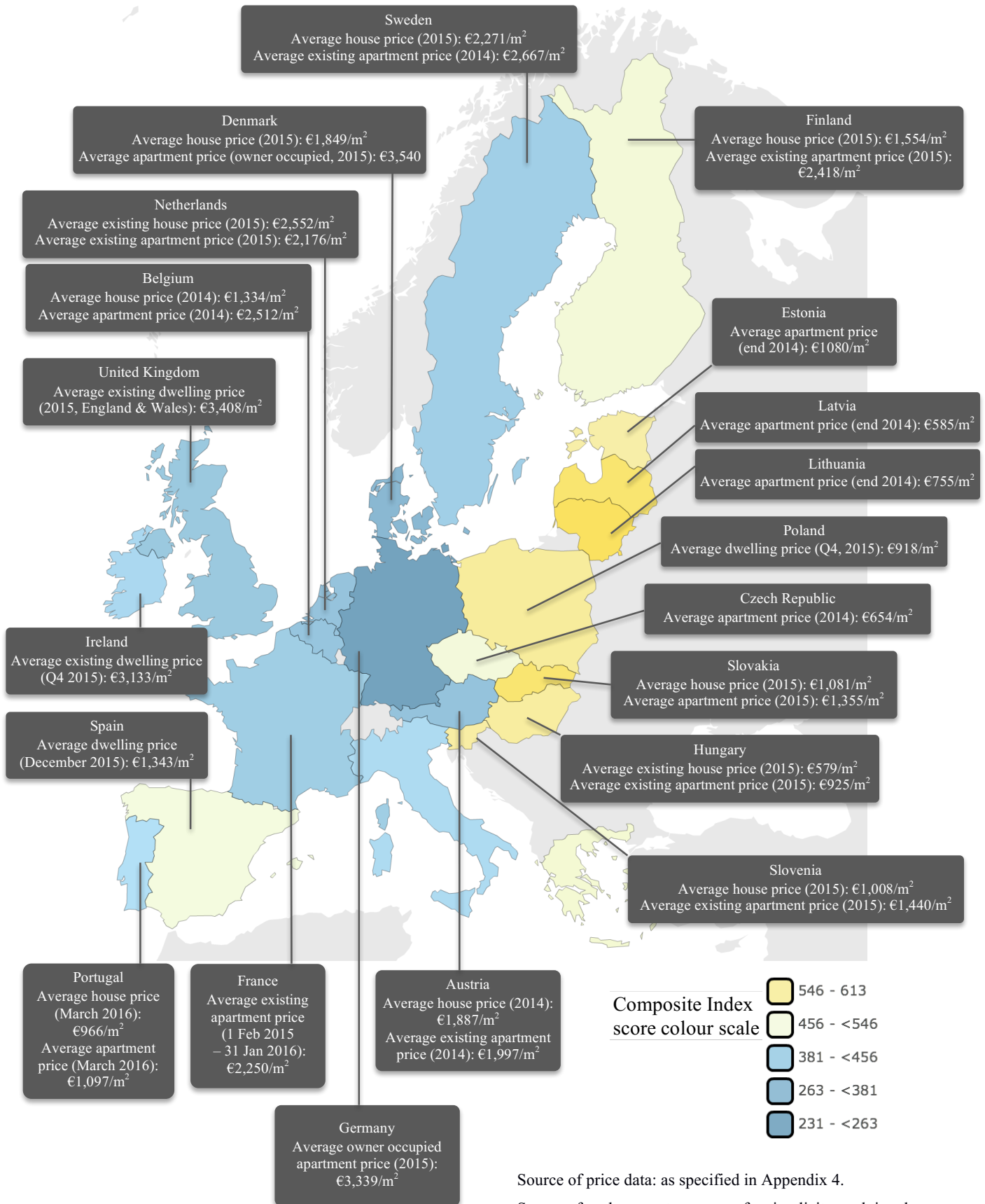
The strategic investment implications arise not only in terms of country selection, but also for tailoring investment strategy *within* national markets. This is because, in each panel country, the contribution of the respective variables to potential price growth varies. By implication, so too the strategic opportunities.

It is perhaps useful to consider the Composite Index rankings against current dwelling price levels. This is assisted by Figure 5.4, on the following page. Onto the same choropleth map featured in Figure 5.3 it overlays the recent average prices of dwellings in the respective countries.³¹ Where possible, prices are separated for houses and apartments, whereby “houses” is applied to mean a fully detached residential dwelling. The average prices are drawn or calculated largely from official statistical sources, as detailed in Appendix 4. They are not harmonised – there is some inherent divergence in what is being measured and how it is measured. For instance, the period of measurement and type of dwelling stock do not neatly align across the sources, and there are minor differences and/or opaqueness in the way average floor area has been measured. Nevertheless, as a broad sketch of relative, aggregate dwelling prices it highlights that the countries with a strong overall Composite Index score also currently have low dwelling prices relative to their panel peers. Conversely, countries with a strong score currently have relatively high dwelling prices.

This observation does not necessarily suggest that national dwelling markets are currently “mispriced”. Price differences are what they are for many reasons – for instance: differences in current income levels; differences in the aggregate standard, age profile and state of repair of countries’ housing stock; differences in taxation frameworks; and so on. Rather, the observation implies price convergence over the long term. It should not be interpreted as implying eventual price parity.

³¹ Two countries, Italy and Greece, are excluded, for lack of reliable suitable data.

Figure 5.4: Choropleth map of Composite Index score, featuring recent average prices of dwellings



Source of price data: as specified in Appendix 4.

Source of exchange rate: xe.com, for simplicity applying the relevant historical mid-market rate as at the day at the end of the data period.

6 Conclusion

This study offers a framework to assess the relative, long-term inflation potential of aggregate, national housing prices in the European Union.

A review of the literature highlights – among other things – that the determinants of housing inflation are known to vary with time horizon, and that the relative importance of factors commonly considered to move aggregate housing price is unsettled.

Critical consideration of the existing studies suggests that the spectrum of factors key to housing inflation in the applicable context may be broader, and more nuanced, than captured in any one existing model to date. This highlights opportunity for further development of the body of knowledge in this area.

Specifically, the key, relevant determinants of housing price drawn from the literature are: future economic growth, future population growth, future population youthfulness, future credit growth, latent demand, super-normal infrastructure investment, supply inelasticity, future climatic change, and cyclical undervaluation. These determinants are largely conventional – they are not foreign to existing models of housing price dynamics. More novel though, is the inclusion of future climatic change, and applying net remittances as a (co-)signal of latent demand. Also, whilst probably not relevant in many other contexts, super-normal investment has been included as an EU-specific factor.

Proxy datasets to represent each variable have been identified. These are sourced respectively from: *The Atlas of Economic Complexity* (expected growth in per capita GDP); United Nations *World Population Prospects* (projected population change); Eurostat *Europop* (projected change in % of population aged 65 and over); European Mortgage Federation *Hypostat* (outstanding loans to disposable income); Eurostat *SILC* (adults living with parents), and World Bank annual remittance data; European Commission *Structural Investment Funding* allocation; Meldelsohn (2000) (market impacts of global warming); Nordregio *Mountain Areas in Europe*, and Eurostat *Land Cover* (water and wetlands); and the OECD *Analytical House Price Database* (index price to income ratio). There is innovation in this sourcing and bundling of proxies. For instance, no known published scholarly research has previously applied *The Atlas of Economic Complexity* to a model of future real estate price.

Panel countries have been measured against each proxy, the measurements converted to a standardised scale to allow comparison between each variable. A neutral weighting has been assigned to each variable.

The countries have subsequently been ranked based on their total aggregate score. The results have been presented and discussed.

The Composite Index indicates that in comparison to other panel countries, “peripheral” national markets generally, and Baltic countries in particular, have greater potential for aggregate housing price growth. Put in the context of current relative price levels, this implies price convergence over the long term.

The reader is cautioned that the Composite Index is a conceptual model. Its results are exploratory in nature. It would be adventurous (at best) to rely on the current Composite Index as investment guidance, and it is not intended as such.

Also, by design, the relative housing inflation potential is considered only at the national aggregate level. This likely masks important sub-national differences. At the regional and local levels significant divergence in price appreciation can be expected. For instance, Égert and Mihaljek (2006) document a tendency in central and eastern Europe for real estate price appreciation to concentrate in the capital cities.

Nonetheless, the Composite Index provides a useful framework for considering the relative prospects for country level housing inflation in the EU. It also highlights that the contribution to potential price growth of the various aggregate price determinants may vary significantly by country.

A potential criticism of the Composite Index is subjectivity in nominating candidate variables. Although nomination criteria are provided and were used, a more transparent and structured approach to nomination and exclusion of potential variables may be valuable.

Another core issue is the relative explanatory power of the variables included in the Composite Index. There is opportunity to optimise their weighting once the data of sufficient time series becomes available.

The Composite Index covers twenty-two of the EU's 27 countries. Countries can be added to the sample once the necessary data becomes available. This includes the pre-accession countries,³² and any other potential future EU members.

The Composite Index seems to have potential for geographic expansion beyond the EU – even perhaps globally. To achieve this, its components will require some adjustment. For instance, the variable of super-normal infrastructure investment may be too EU specific, and thus require removal or a different proxy. This is a matter for potential future research.

The Composite Index concerns the real estate asset class of housing. Future research may involve applying a similar approach to other real estate classes – office, retail, industrial, agricultural and horticultural, tourism, and so on.

³² Of Albania, Macedonia, Montenegro and Serbia.

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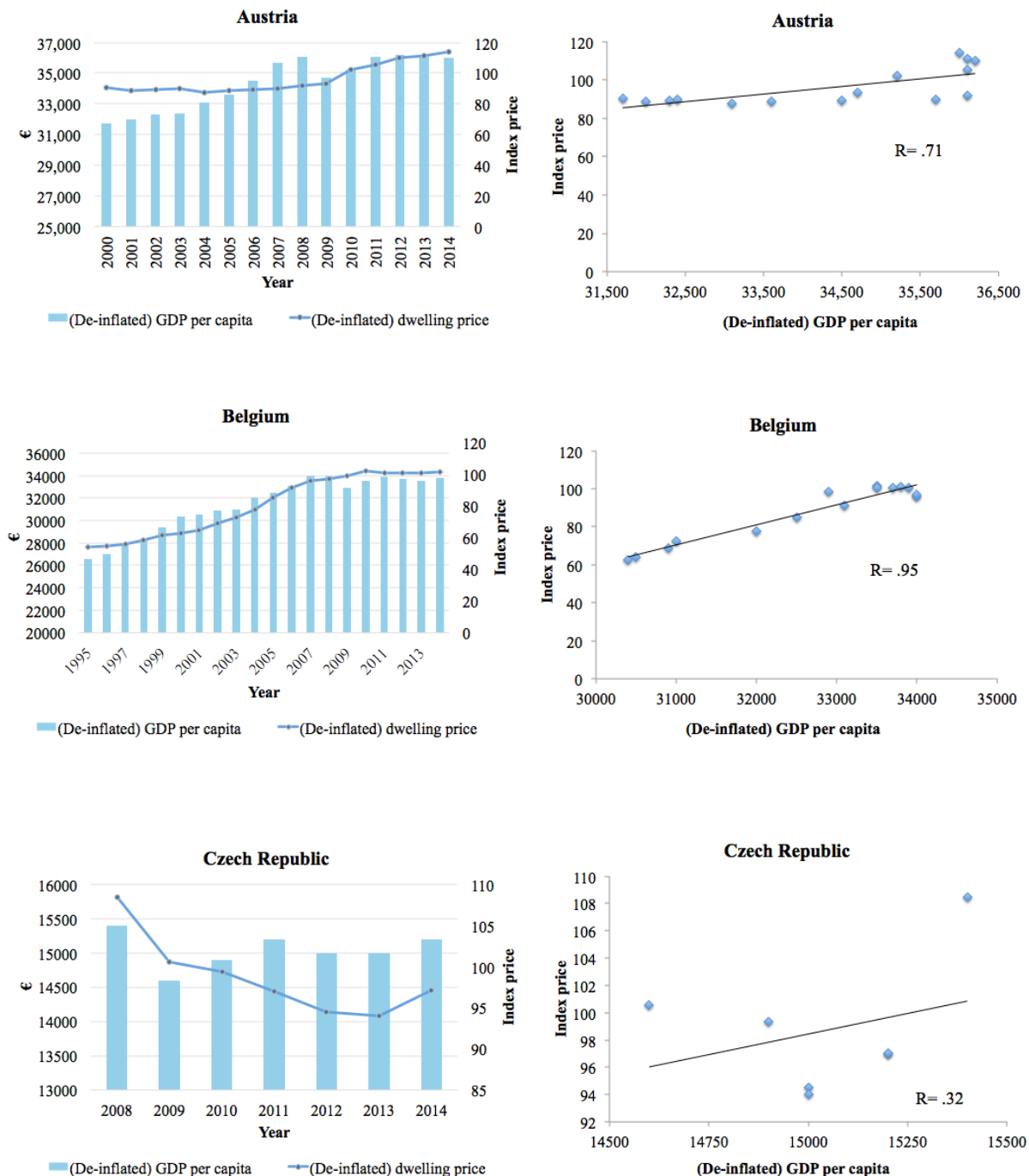
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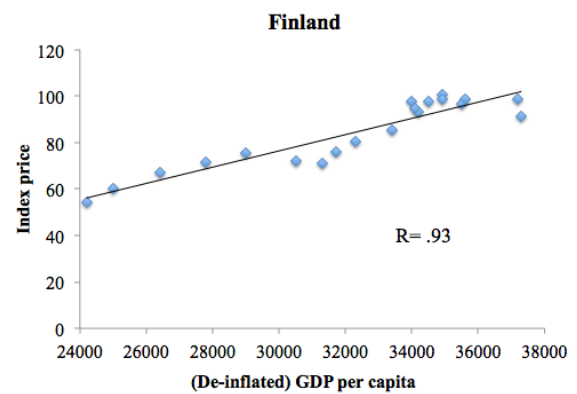
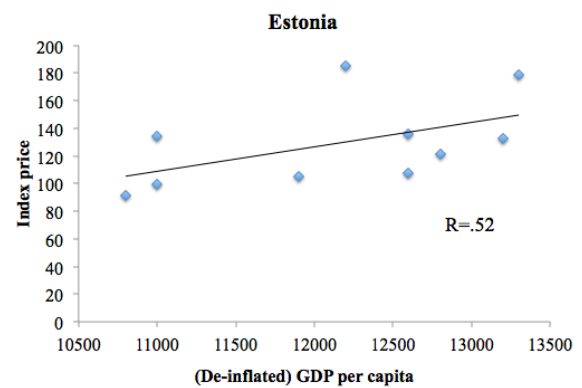
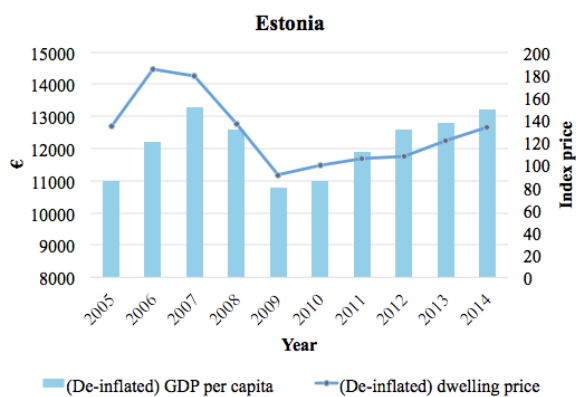
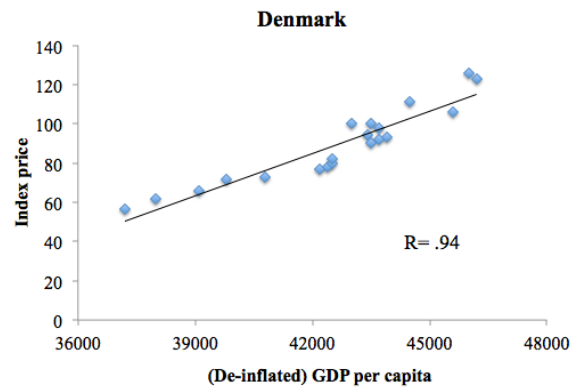
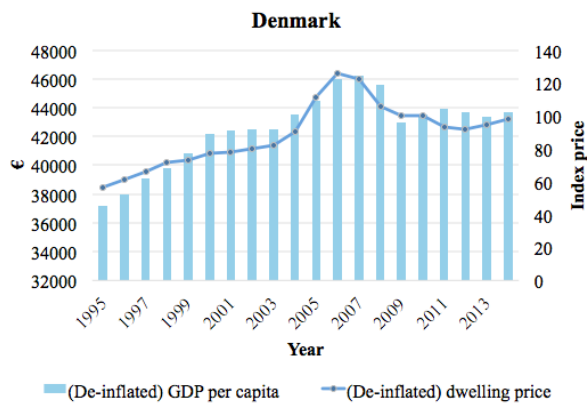
Appendices

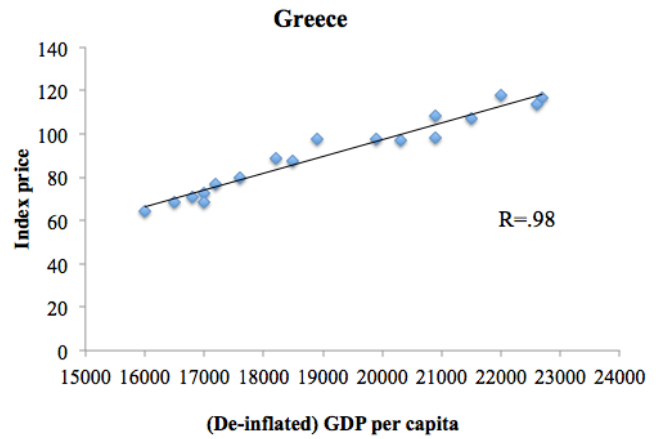
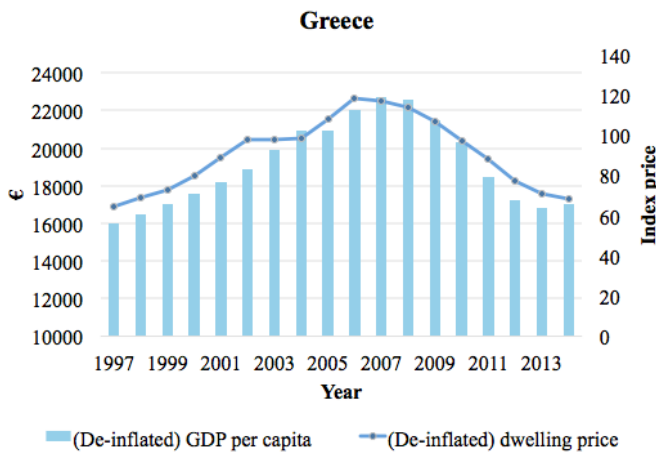
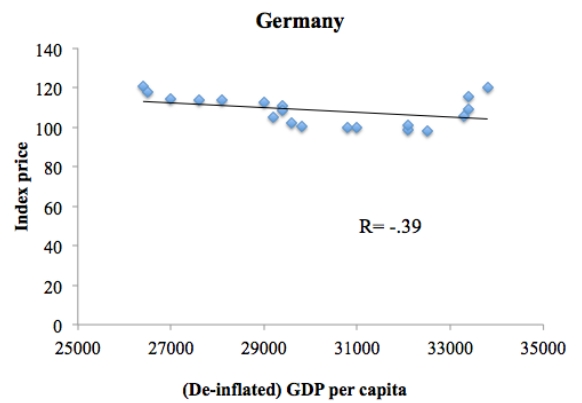
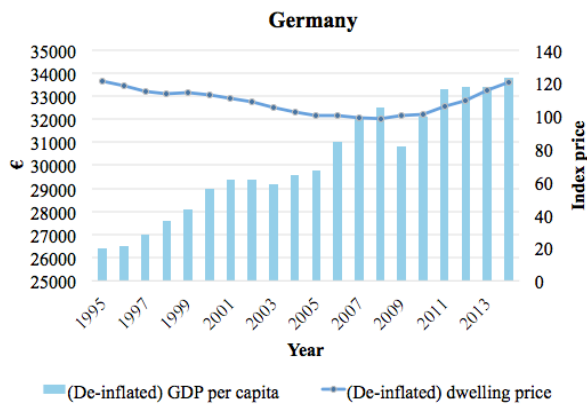
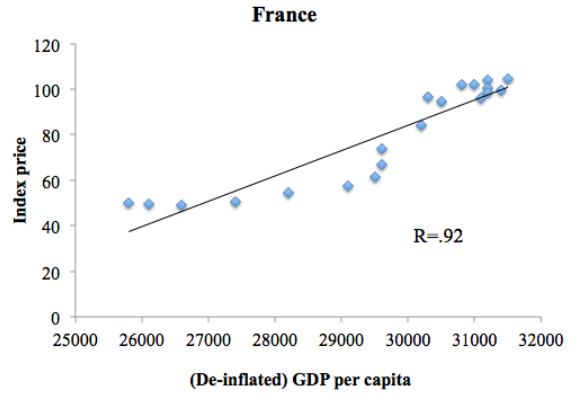
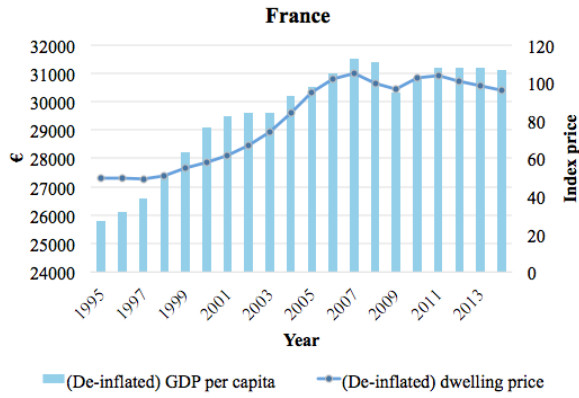
Appendix 1 – *Correlation between GDP per capita and dwelling price, by country*³³

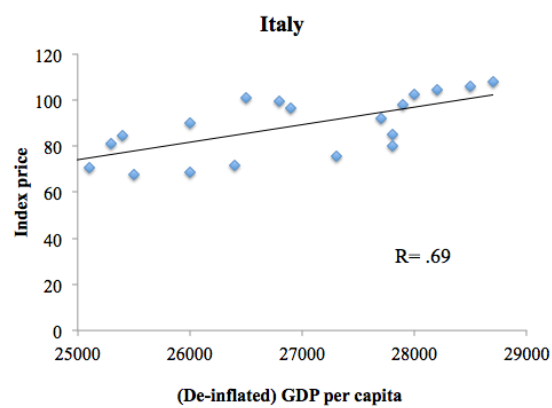
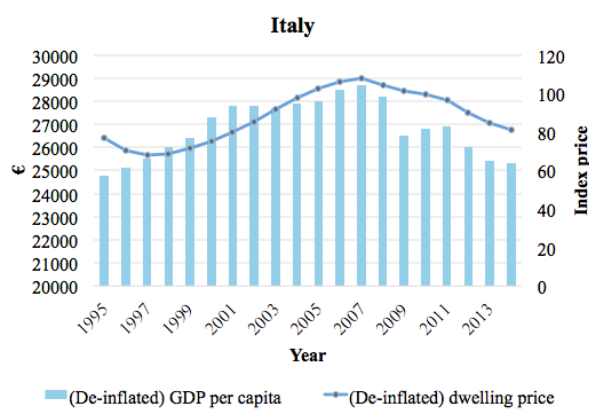
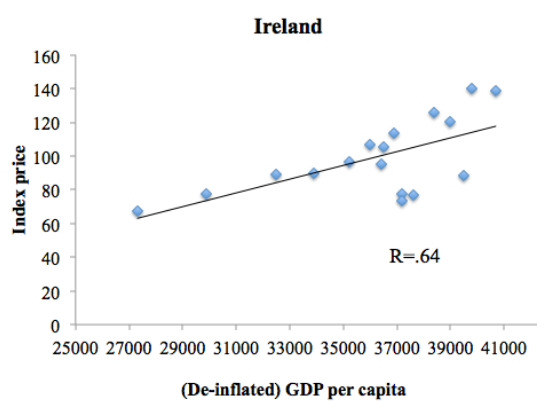
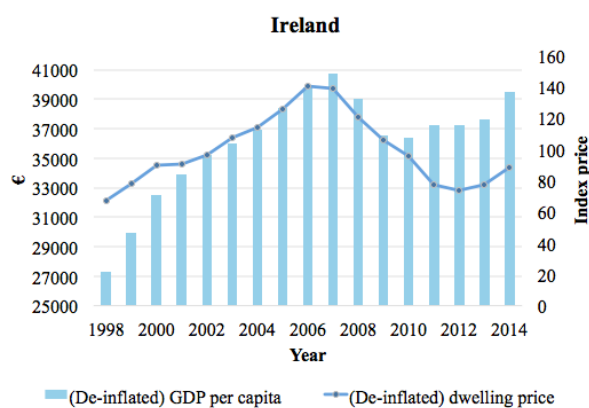
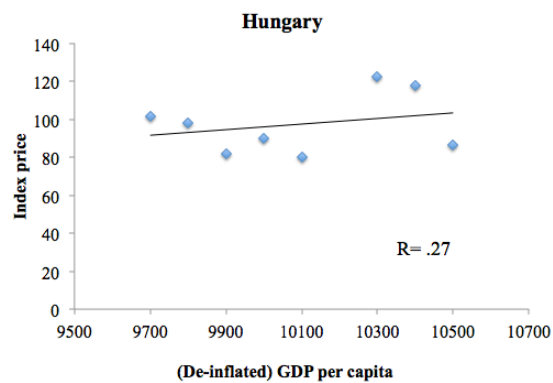
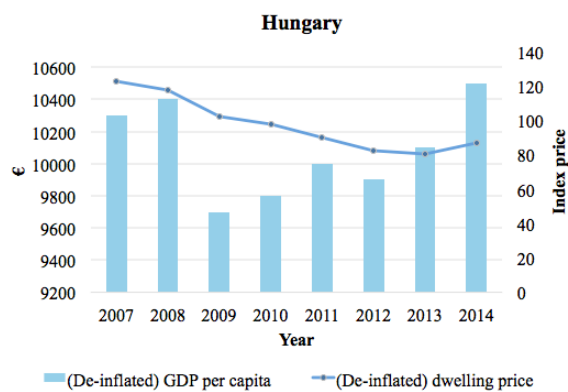
Datasets: OECD Analytical House Price Data, real house prices, Q4, (2010=100); and Eurostat (2016).

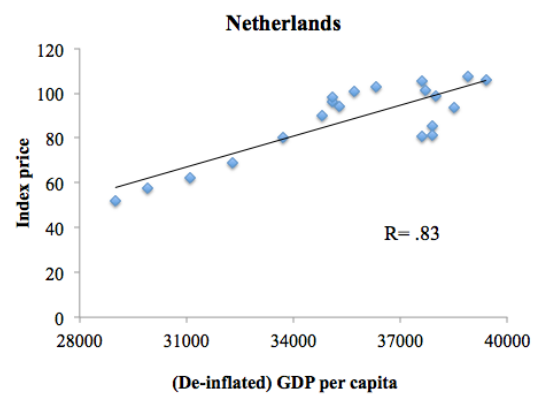
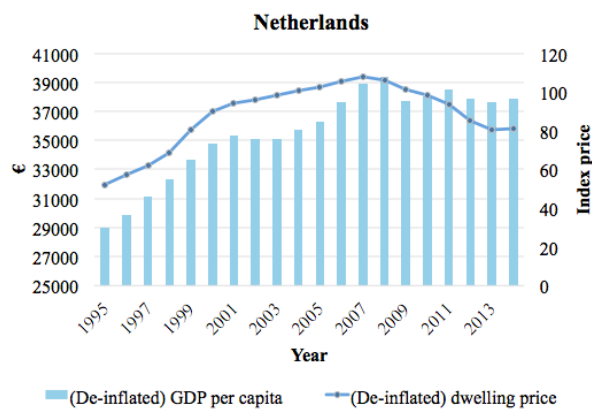
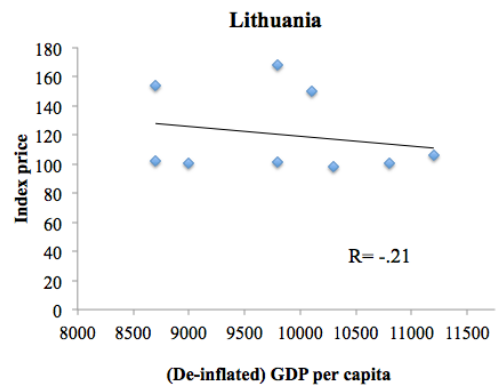
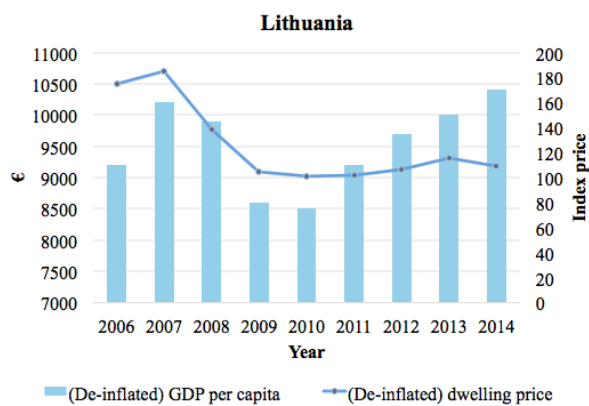
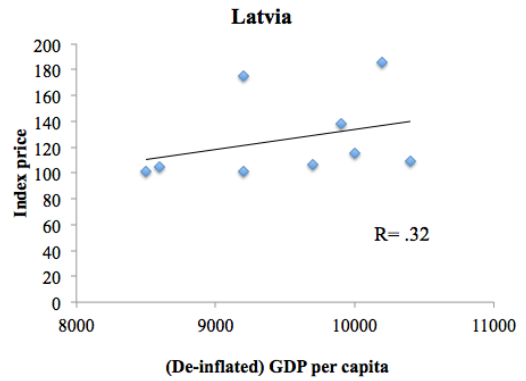
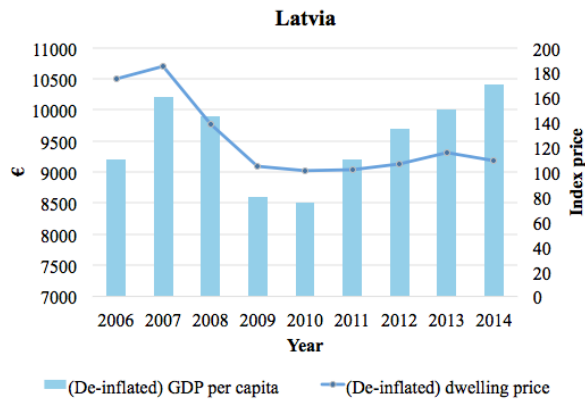


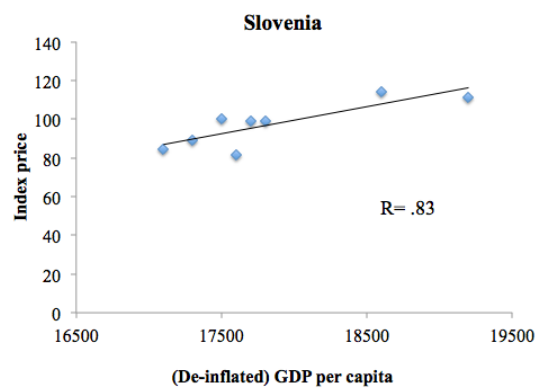
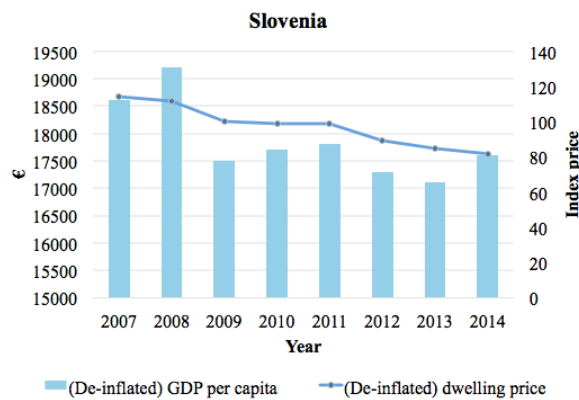
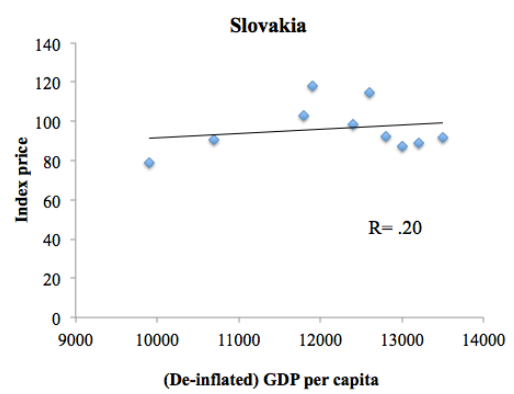
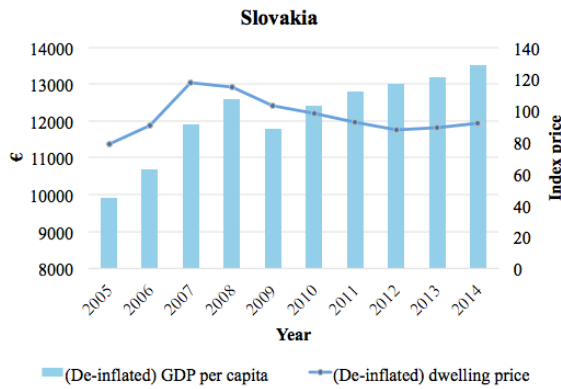
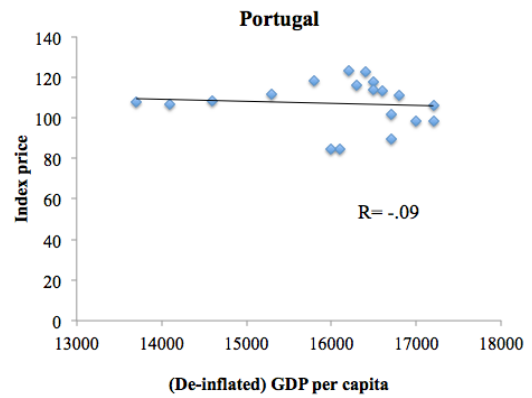
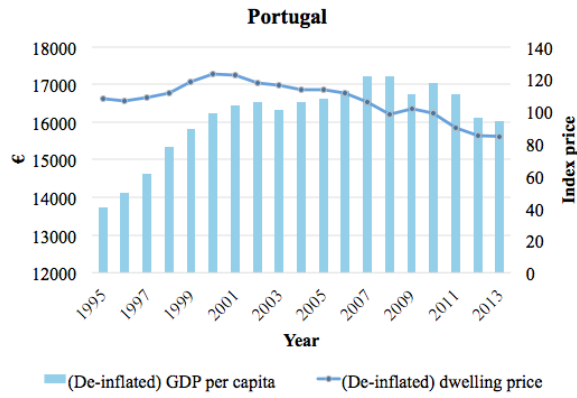
³³ Poland is not included, as the dataset used did not contain house price data for that country.

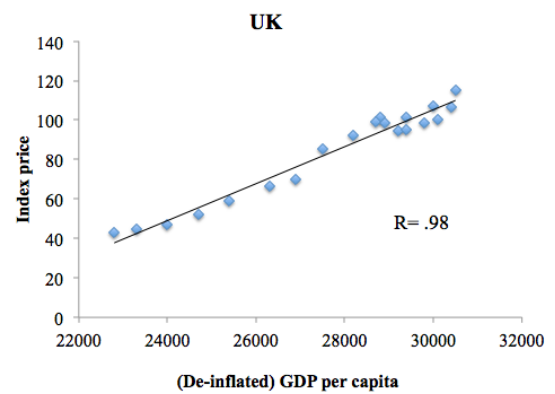
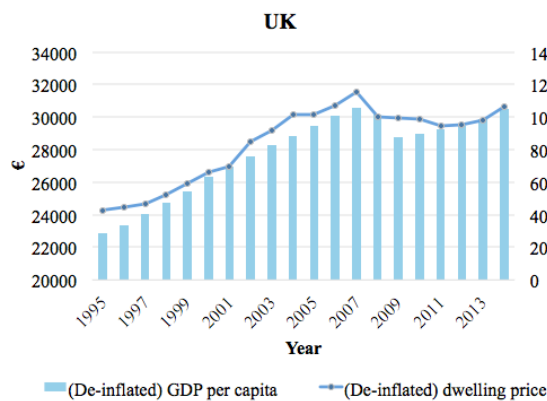
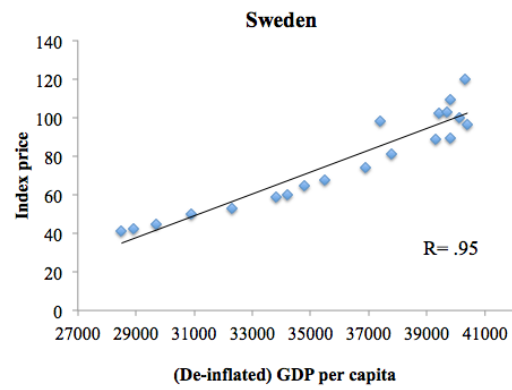
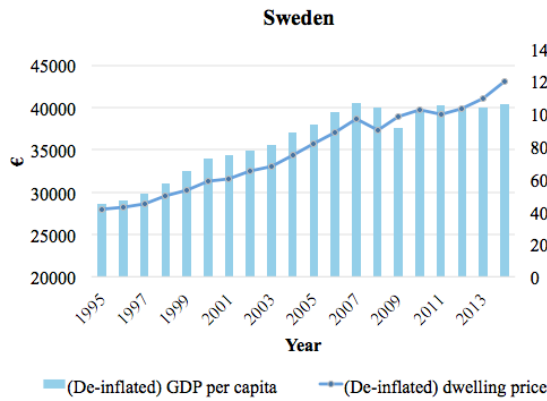
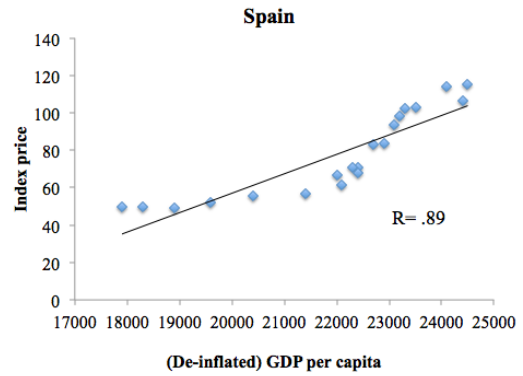
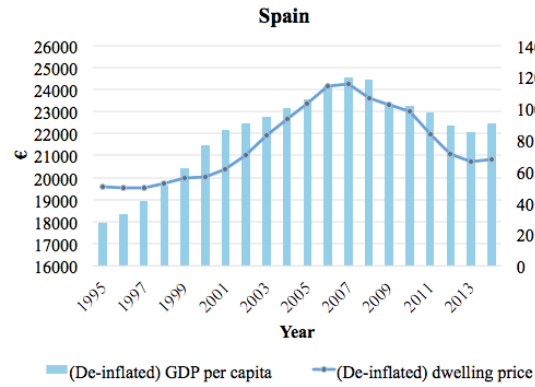






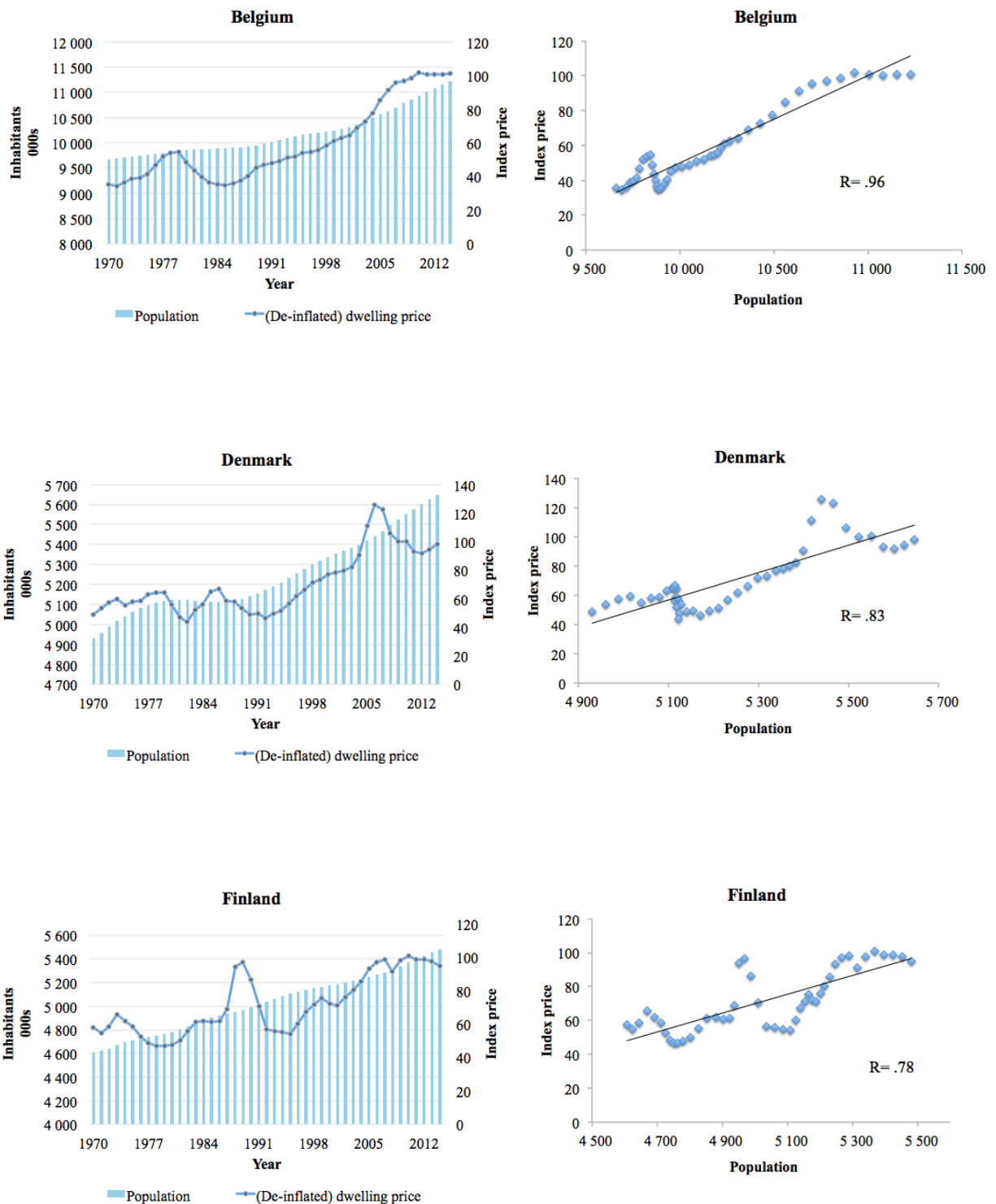


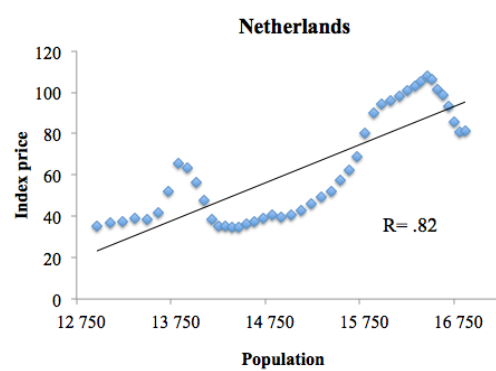
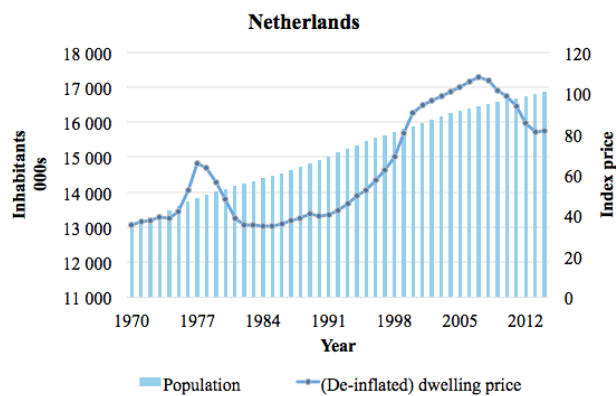
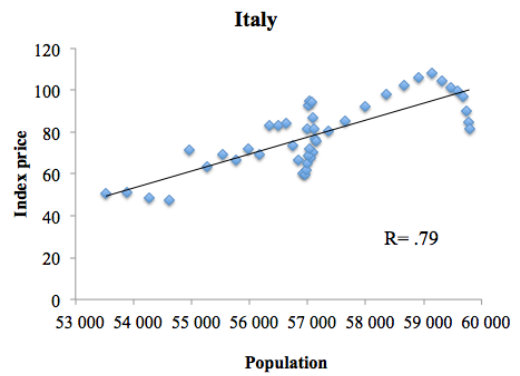
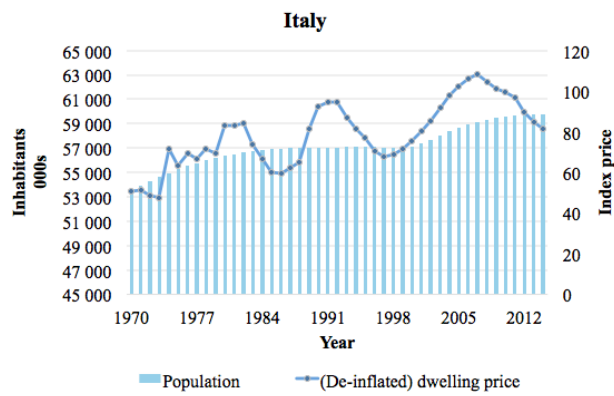
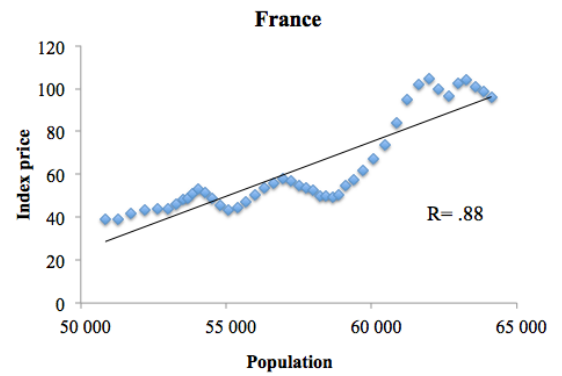
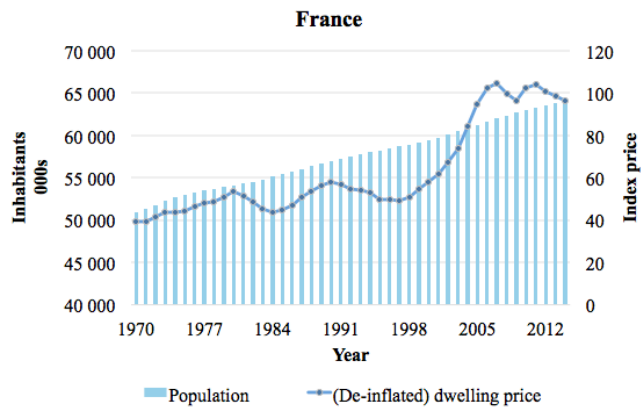


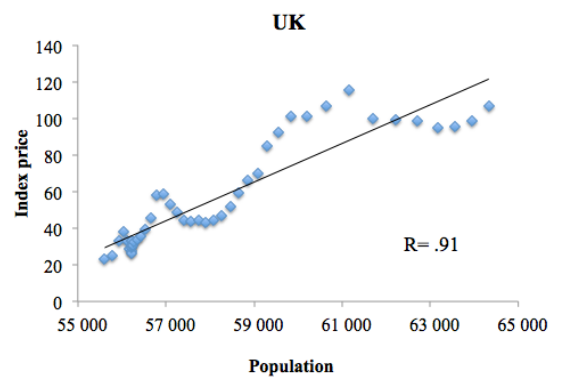
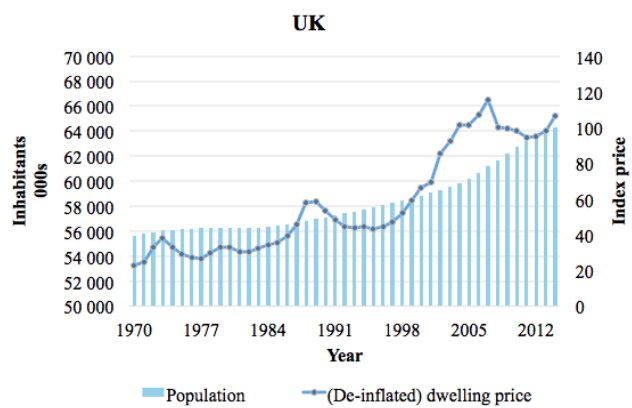
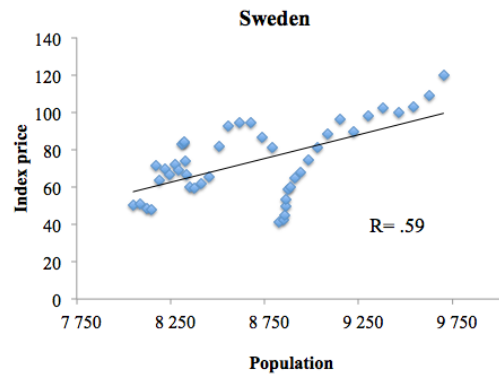
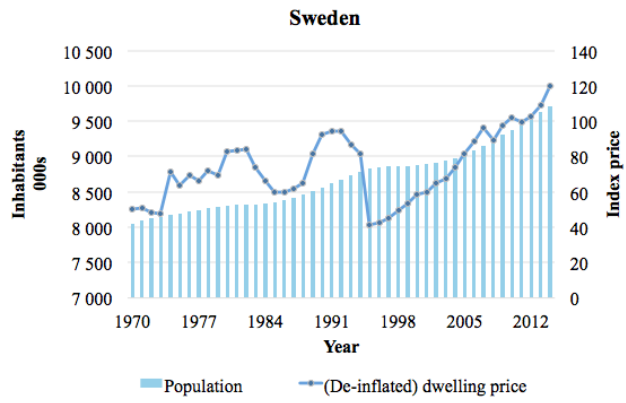


Appendix 2 – Correlation between population and dwelling price, by country

Datasets: OECD Analytical House Price Data, real house price, Q4, (2010=100);
and World Population Prospects (United Nations, 2015), total population, estimates 1950–2015.

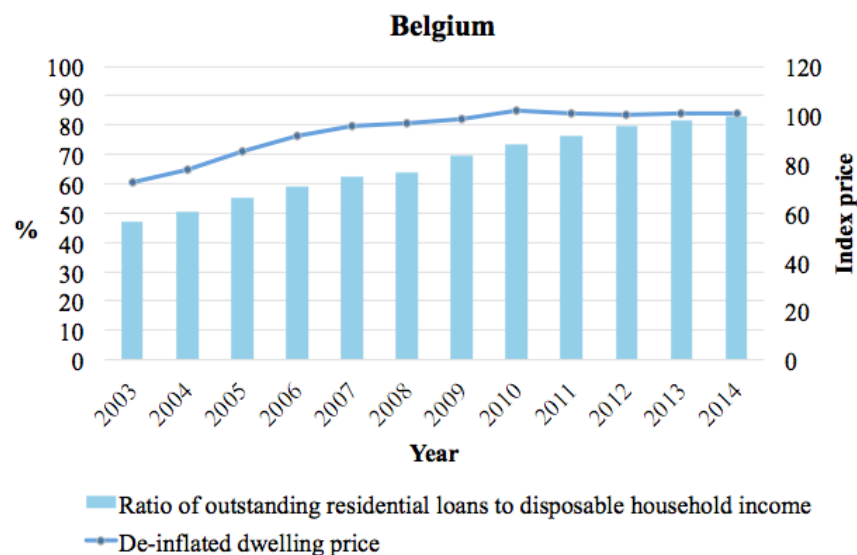
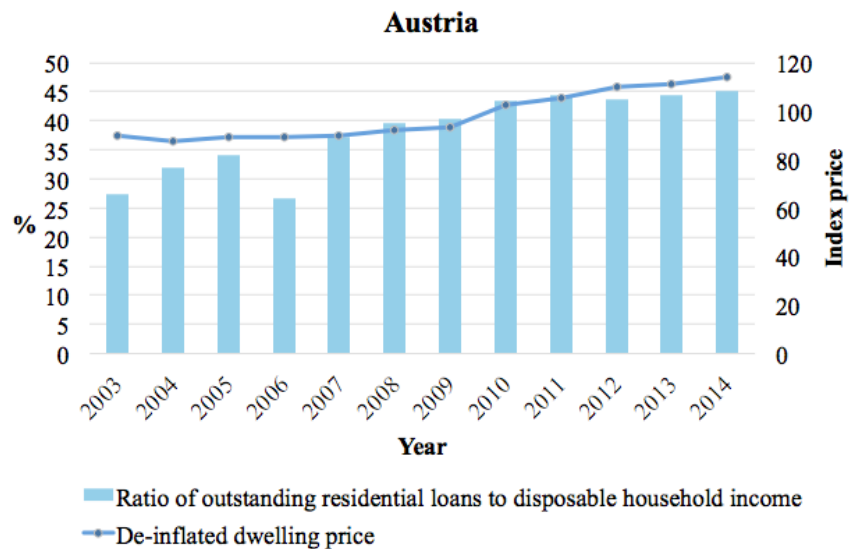




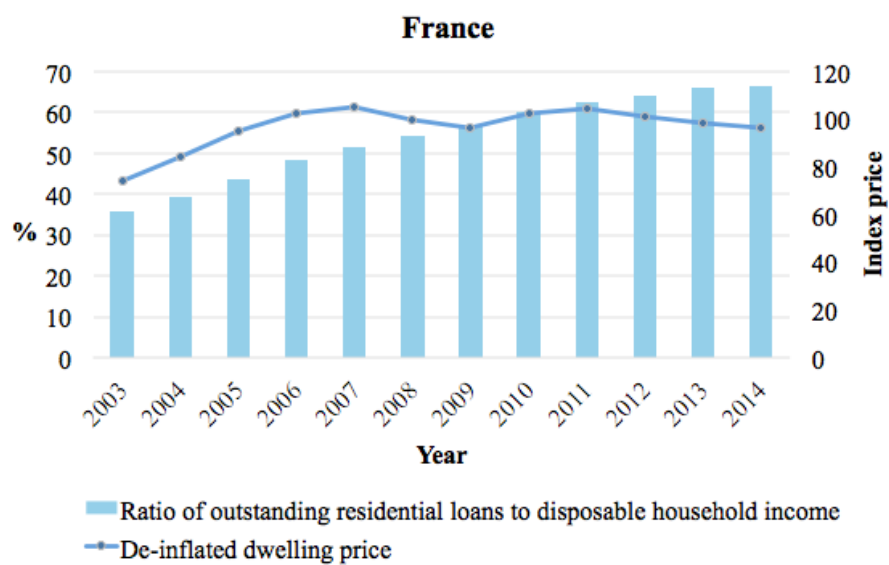
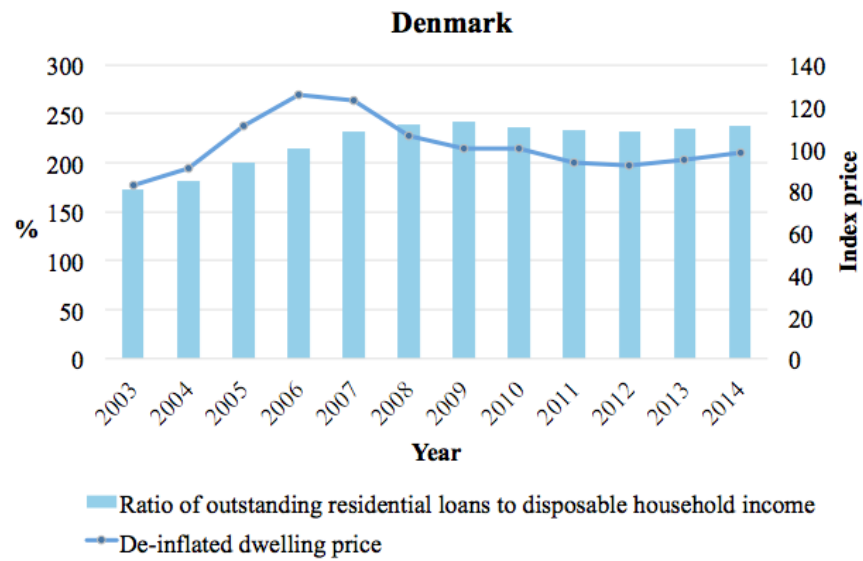


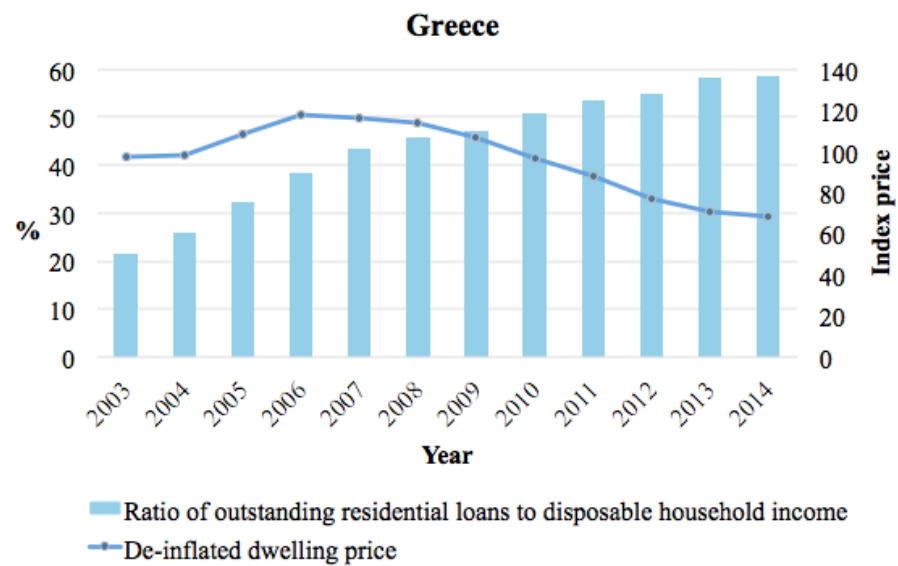
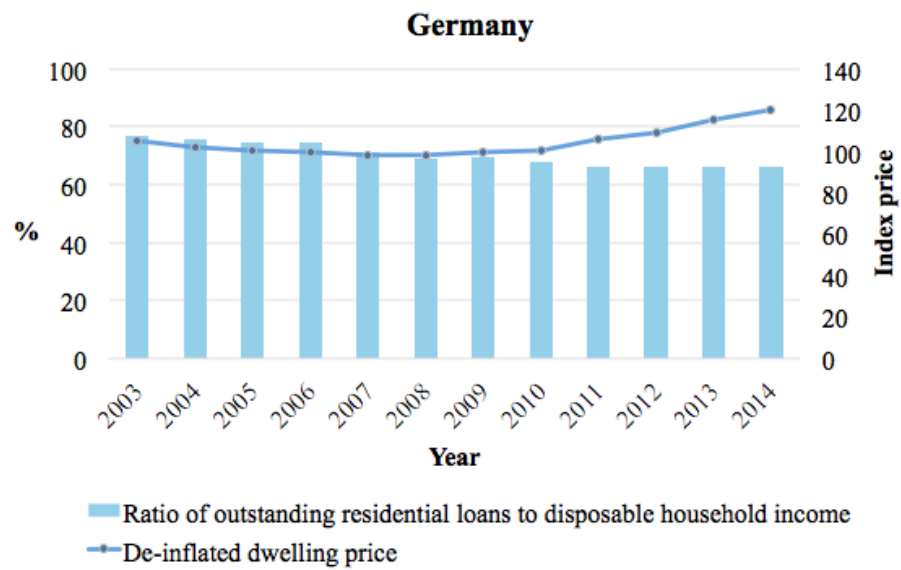
Appendix 3 – *Movement of credit volume and dwelling prices, by country*³⁴

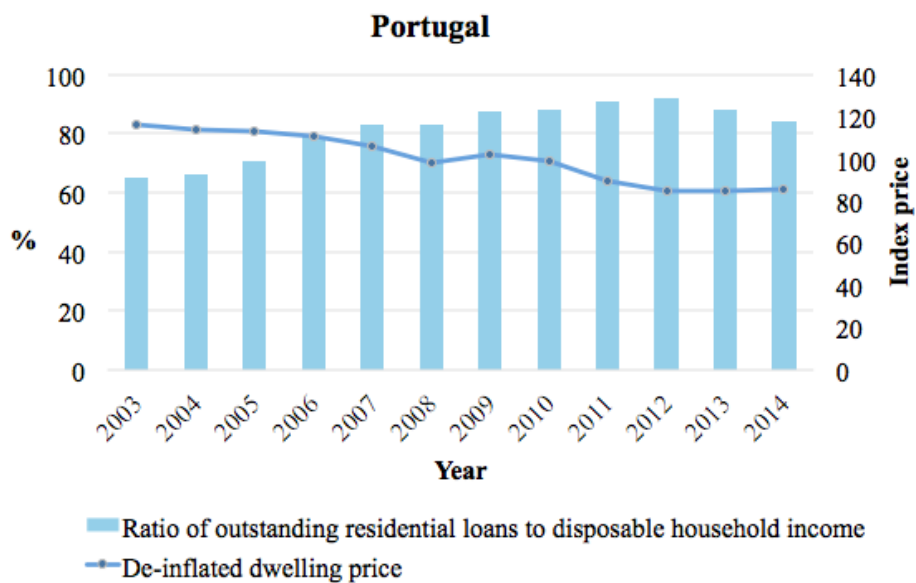
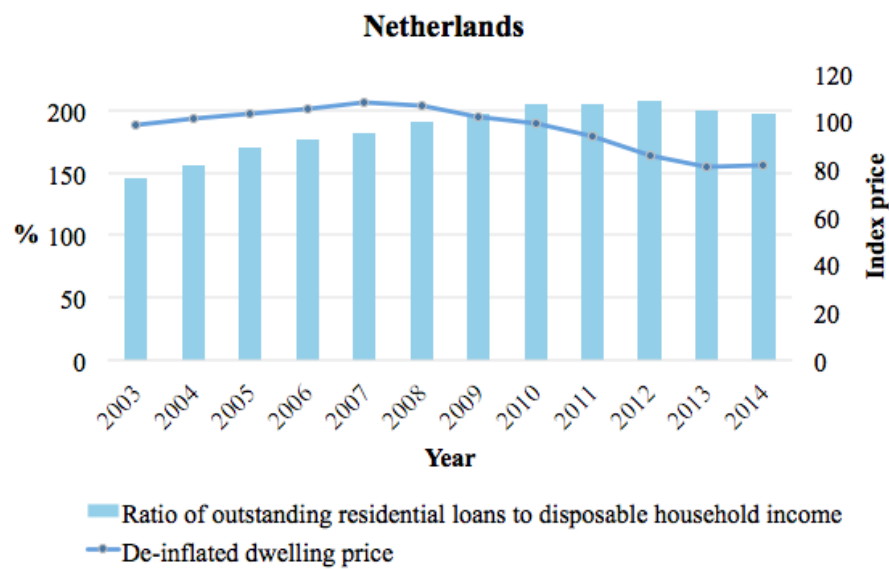
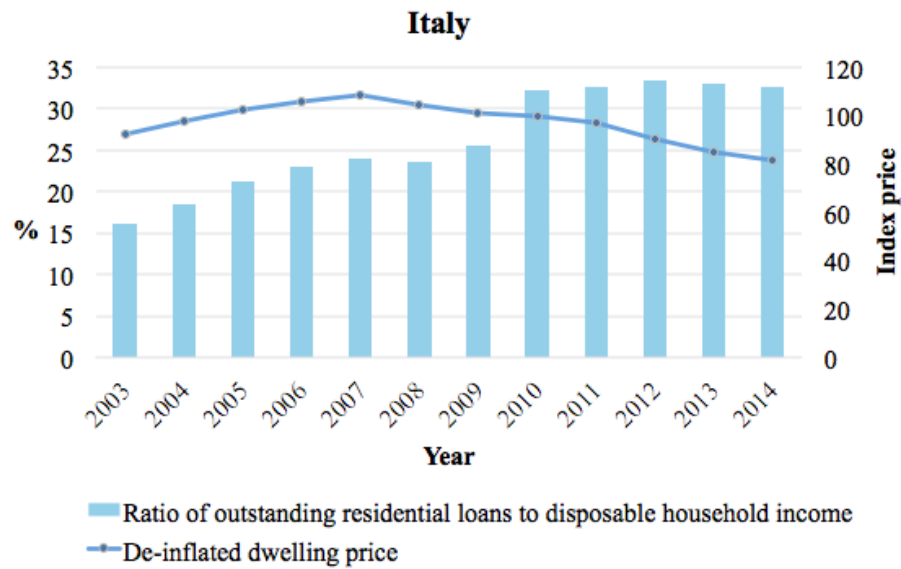
Datasets: OECD Analytical House Price Data, real house prices, Q4, (2010=100); and European Mortgage Federation (2015, 91).

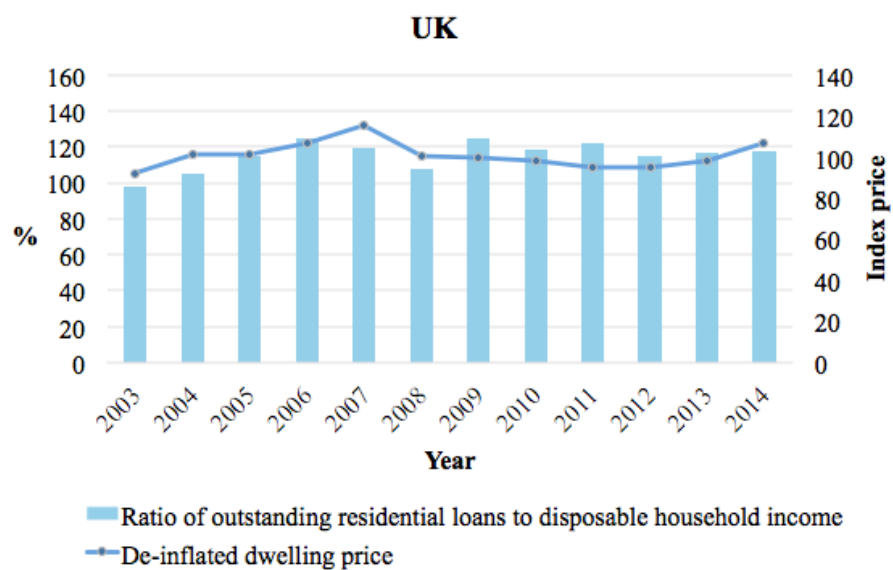
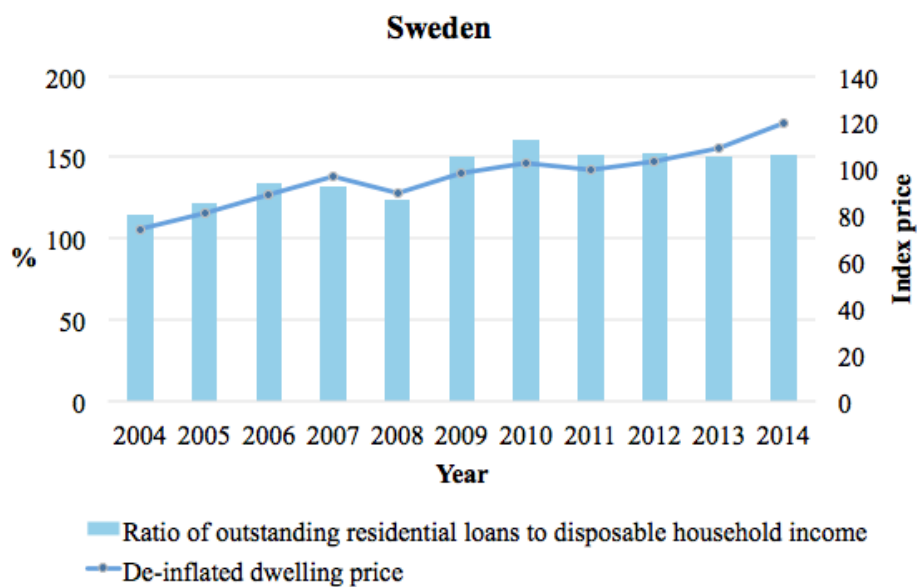
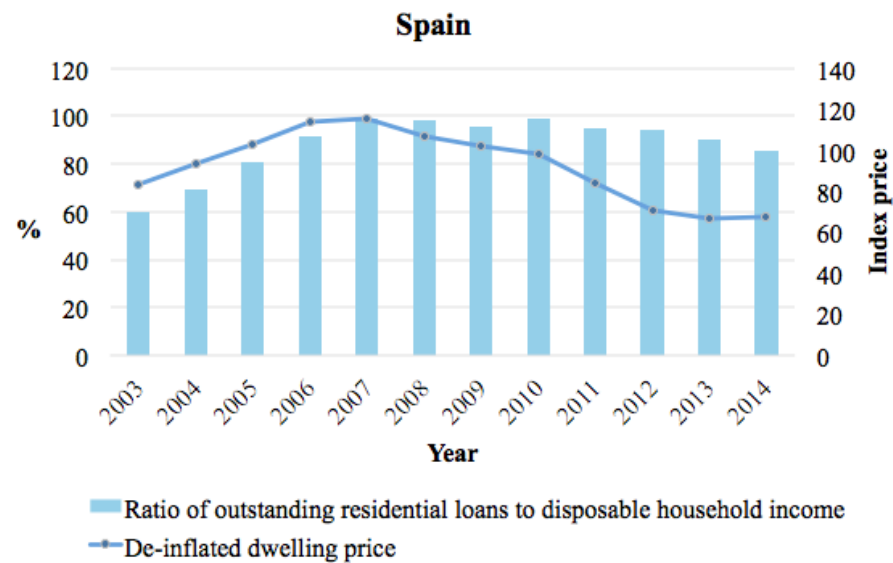


³⁴ The countries included here are those for which corresponding data was available in the dataset pair for the maximum period of 2003 to 2014. Note that for Sweden year 2003 is excluded, as the Hypostat source seems to contain a data error for that year.









Appendix 4 – Source data for recent national dwelling prices in Figure 5.4

Country	Sales price data	Dwelling size data	Comment
Austria	Austrian Economic Chambers (2015)		Not an official source, but nonetheless authoritative.
Belgium	Statistics Belgium (2015)	Statec (2014, 1)	The price data relates to all relevant transactions in year 2014, whereas the dwelling floor area data represents the country's stock as at 2012. Whilst this affects the price per square metre estimates, the likely impact is considered acceptable for present purposes.
Czech Republic	Czech Statistical Office (2015)		
Denmark	Statistics Denmark (2016a)	Statistics Denmark (2016b)	Although nominally from the same year, the price data relates to transactions throughout the year, whereas the dwelling size data is drawn from a housing census. Again, the likely impact on the estimate is considered acceptable for present purposes.
Estonia	Estonian Land Board et al. (2015, 11)		
Finland	Statistics Finland (2016)		
France	High Council of Notaries (2016)		An authoritative, quasi-official source relied upon by the official statistics body – see for instance, Bessone et al (2005, 14).
Germany	Bulwiengesa (2015, 4)		Not an official source, but a research and consulting firm. Nonetheless it is considered sufficiently independent and authoritative. Note that its data is compiled not exclusively from sales transactions, but also valuations and expert opinion.
Greece	–	–	Official statistics not readily available.
Hungary	Hungarian Central Statistical Office (2016)		
Ireland	Central Statistics Office (2016)	Eurostat (2014)	The transaction data pool relates to a particular quarter, whereas the floor-space data represents relevant total stock. This is considered suboptimal, but acceptable for present purposes.
Italy	–	–	Official statistics not readily available.
Latvia	Estonian Land Board et al. (2015, 24)		
Lithuania	Estonian Land Board et al. (2015, 36)		
Netherlands	Statistics Netherlands (2016)	Statistics Netherlands (2013)	The price data is derived from the average price of transactions in the particular year, whereas the floor-space data is intended to represent relevant total stock. This is considered sub-optimal, but acceptable for present purposes.
Poland	Central Statistical Office of Poland (2016)		
Portugal	Statistics Portugal (2016)		Relies on bank mortgage valuation data rather than sales transactions.
Slovakia	National Bank of Slovakia (2016)		
Slovenia	Surveying and Mapping Authority (2016, 32 & 36)		
Spain	General Council of Notaries (2016)		
Sweden	Statistics Sweden (2016)	Statistics Sweden (2015)	The price data relates to transactions throughout the respective years, whereas the dwelling size data represents a broader stock pool, and at a slightly earlier <i>point</i> in time. The likely impact on the estimates is considered acceptable for present purposes.
United Kingdom	U.K. Land Registry (2016)	Halifax (2015, 7)	The respective data pools vary in size and geographic coverage, and the Halifax data is based on mortgaged properties. They are nonetheless considered sufficiently compatible for present purposes.

Appendix 5 – Raw data for Composite Index

COUNTRY	<i>Atlas of Economic Complexity</i> Expected Growth in Per Capita GDP (to 2024) (%)	<i>U.N. World Population Prospects: The 2015 Revision.</i> Average annual range of population change, medium fertility variant, 2015–2030 (%)	European Union European Structural & Investment Funding 2014 –2020 (€ M)	U.N. World Population Prospects: The 2015 Revision. Population 2015	Calculated infrastructure bonus per capita (€)	<i>Europop 2013,</i> Projection of persons aged 65 & over, % change 2020–2060
Austria	1.66	0.23	€5,180	8,544,586	606	81.4
Belgium	2.61	0.41	€2,877	11,299,192	255	84.8
Czech Repub.	3.11	-0.05	€24,184	10,543,186	2,294	74.1
Denmark	2.5	0.38	€1,391	5,669,081	245	58.9
Estonia	3.18	-0.36	€4,417	1,312,558	3,365	36.1
Finland	3.05	0.24	€3,921	5,503,457	712	56.7
France	2.77	0.36	€26,350	64,395,345	409	60.8
Germany	0.35	-0.12	€27,672	80,688,545	343	34.1
Greece	2.85	-0.30	€20,107	10,954,617	1,835	25.9
Hungary	3.33	-0.40	€25,400	9,855,023	2,577	57.2
Ireland	3.08	0.70	€3,526	4,688,465	752	97.2
Italy	1.83	-0.08	€43,790	59,797,685	732	55.6
Latvia	2.76	-0.58	€5,621	1,970,503	2,852	3
Lithuania	2.99	-0.54	€8,500	2,878,405	2,953	-12.8
Netherlands	2.56	0.26	€2,113	16,924,929	125	62.9
Poland	3.26	-0.25	€89,039	38,611,794	2,306	96.4
Portugal	3.12	-0.33	€25,915	10,349,803	2,504	38.1
Slovakia	3.42	-0.09	€15,898	5,426,258	2,930	122.5
Slovenia	3.11	-0.05	€3,937	2,067,526	1,904	68.2
Spain	3.46	-0.03	€38,012	46,121,699	824	66
Sweden	2.73	0.64	€3,971	9,779,426	406	71.1
U.K.	3.22	0.53	€14,663	64,715,810	227	78.9
min	0.35	-0.6			124.9	-12.8
max	3.46	0.7			3365.1	122.5
range	3.11	1.3			3240.2	135.3

COUNTRY	(A) Eurostat <i>Statistics on Income and Living Conditions</i> – share of young adults aged 18– 34 living with parents (30 October 2015 update), year 2013 (%)	(B) Hofstede (2010) Individualism Dimension (0-100)	(C) Eurostat <i>Statistics on Living Conditions</i> – dwelling overcrowding rate, year 2014 (%)	Calculated (A)*(B+C)	Nordic Centre for Spatial Development, 2004, mountain area as a % of total country area	<i>Eurostat 2013</i> , water & wetlands cover as a % of total country area
Austria	47	55	15	3,283	73.4	4.9
Belgium	45	75	2	3,442	4.2	1.8
Czech Repub.	54	58	21	4,234	32.3	2.3
Denmark	16	74	9	1,318	0.0	3.7
Estonia	41	60	21	3,317	0.0	8.2
Finland	21	63	7	1,433	50.8	16.3
France	35	71	7	2,705	22.3	2.4
Germany	42	67	7	3,118	14.7	2.9
Greece	62	35	27	3,881	77.9	5.2
Hungary	65	80	46	8,133	4.7	4.3
Ireland	44	70	3	3,210	10.6	9.2
Italy	66	76	27	6,797	60.1	5.0
Latvia	52	70	38	5,611	0.0	7.0
Lithuania	54	60	28	4,708	0.0	4.5
Netherlands	36	80	3	2,949	0.0	12.3
Poland	60	60	45	6,319	5.2	3.1
Portugal	61	27	11	2,327	39.1	5.3
Slovakia	74	52	40	6,802	62.0	1.7
Slovenia	61	27	16	2,594	78.0	2.7
Spain	55	51	5	3,097	55.7	5.7
Sweden	24	71	11	1,965	50.6	12.7
U.K.	34	89	8	3,317	25.5	6.3
min				1,318	0.0	1.7
max				8,133	78.0	16.3
range				6,815	78.0	14.6

COUNTRY	The World Bank <i>Annual Remittances Data</i> 2013 inflows, (October 2015 release) (USD million)	The World Bank <i>Annual Remittances Data</i> 2013 outflows, (October 2015 release) (USD million)	Calculated net remittance inflows	World Bank – 2013 GDP (USD, current)	Calculated net remittance relative to GDP (%)
Austria	3,193	3,625	-431,703,597	428,321,937,480	-0.10
Belgium	11,131	4,470	6,661,804,250	524,778,837,630	1.27
Czech Repub.	1,738	1,079	658,685,717	208,796,024,646	0.32
Denmark	1,217	3,060	-1,842,821,576	335,877,548,364	-0.55
Estonia	536	100	435,566,378	24,880,264,958	1.75
Finland	1,066	948	117,496,895	268,196,956,060	0.04
France	23,336	13,418	9,918,755,949	2,810,249,215,589	0.35
Germany	16,984	19,870	-2,886,002,664	3,730,260,571,357	-0.08
Greece	805	1,291	-486,373,341	242,230,732,091	-0.20
Hungary	4,325	989	3,335,948,608	133,423,898,612	2.50
Ireland	724	1,958	-1,233,869,311	232,077,367,193	-0.53
Italy	6,652	2,713	3,939,426,968	2,136,948,255,816	0.18
Latvia	764	73	691,288,890	30,908,761,928	2.24
Lithuania	2,060	852	1,208,096,902	46,403,189,419	2.60
Netherlands	1,619	9,685	-8,066,088,993	853,539,351,964	-0.95
Poland	7,027	1,413	5,614,000,000	526,064,038,474	1.07
Portugal	4,372	1,231	3,141,428,502	224,912,480,765	1.40
Slovakia	2,072	175	1,896,446,067	97,712,677,179	1.94
Slovenia	593	130	462,668,552	47,989,855,095	0.96
Spain	10,625	8,772	1,852,835,295	1,393,040,177,014	0.13
Sweden	4,202	1,190	3,012,354,611	579,526,008,582	0.52
U.K.	1,717	2,225	-508,423,149	2,678,173,487,557	-0.02
min					-0.95
max					2.60
range					3.55

COUNTRY	Mendelsohn et al. (2000), 2° warming by 2100, GDP impact (%)	<i>Hypostat 2015</i> , total outstanding residential loans to household disposable income ratio, year 2014 (%)	OECD <i>Analytical House</i> <i>Price Database</i> – Affordability (dwelling price to income ratio), Q2 2015	Calculated undervaluation (based on price/income historical average) %
Austria	0	45.1	117.35	-17.35
Belgium	0	83.1	104.79	-4.79
Czech Repub.	0.25	31.2	97.55	2.45
Denmark	0.25	237.4	104.49	-4.49
Estonia	1	54.1	116.74	-16.74
Finland	0.25	73.7	95.91	4.09
France	0	66.4	95.88	4.12
Germany	0	66	116.06	-16.06
Greece	0	58.7	87.00	13.00
Hungary	0.25	29.1	83.01	16.99
Ireland	0.25	101.7	93.43	6.57
Italy	0	32.6	86.87	13.13
Latvia	1	32.9	92.91	7.09
Lithuania	1	26.2	93.88	6.12
Netherlands	0	197.3	83.45	16.55
Poland	1	34	85.00	15.00
Portugal	0	83.9	94.94	5.06
Slovakia	1	37.6	92.85	7.15
Slovenia	0.5	23.5	86.15	13.85
Spain	0	84.6	74.25	25.75
Sweden	0.25	151	113.68	-13.68
U.K.	0	116.4	107.36	-7.36
min	0	23.5		-17.35
max	1	237.4		25.75
range	1	213.9		43.10